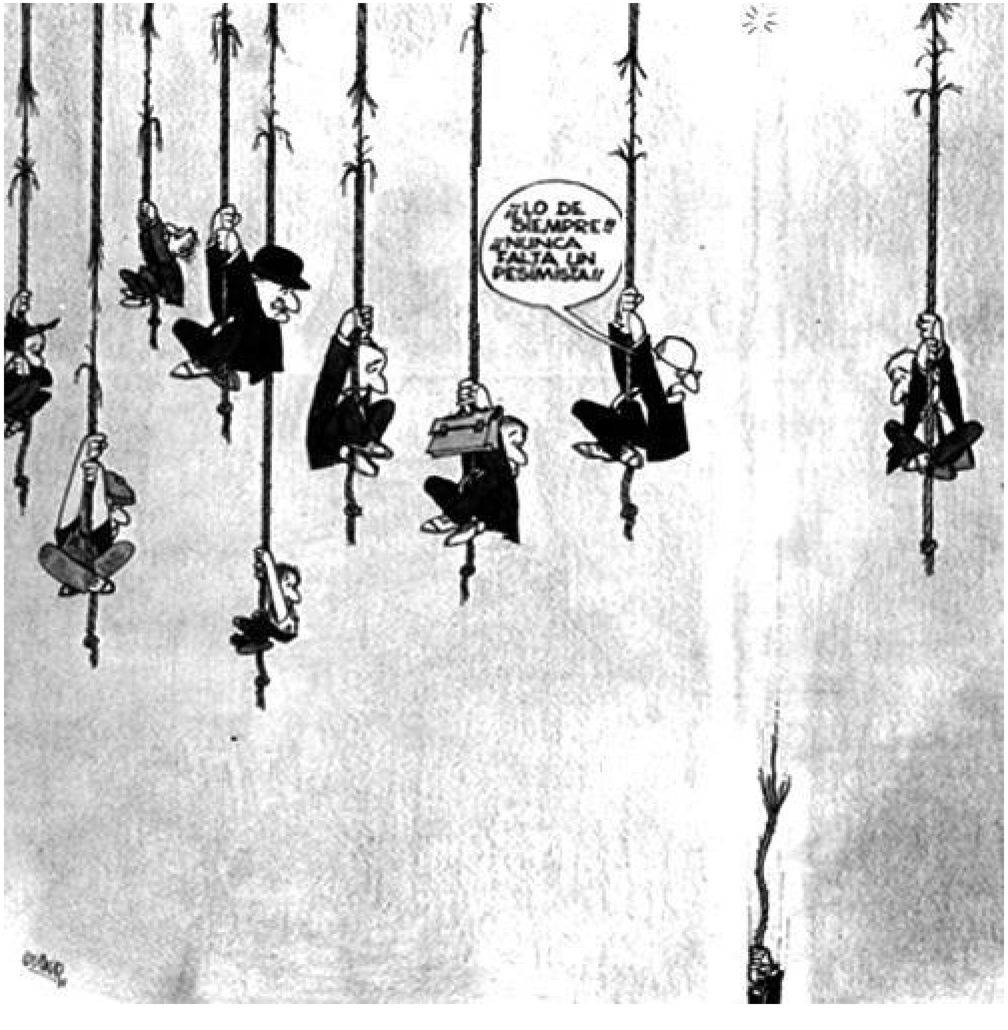
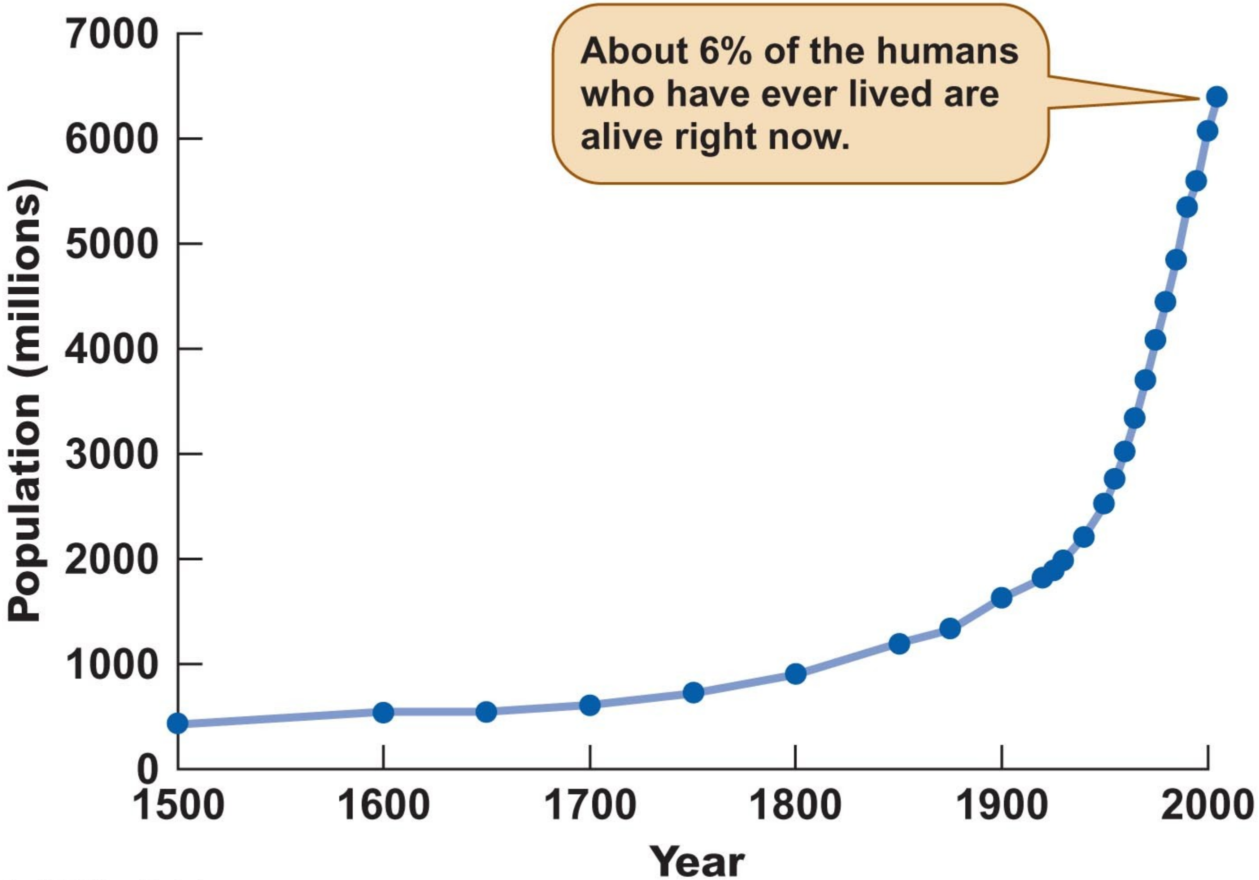
Perturbaciones ambientales y conservación de las interacciones planta-polinizador



Esquema de la charla

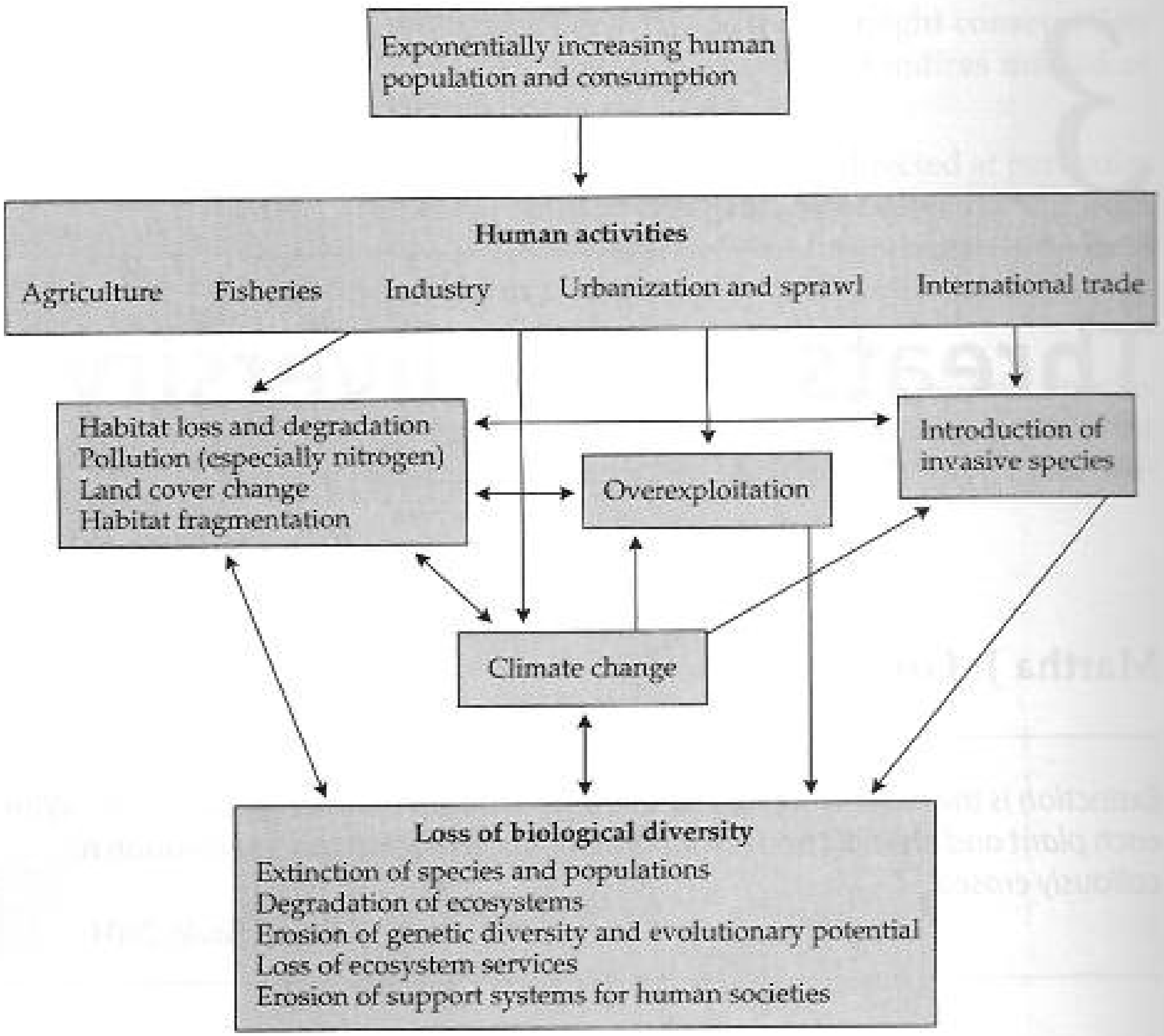
- Impactos humanos en los ecosistemas
- Efectos humanos sobre la polinización
- Efectos humanos sobre los polinizadores
- Efeitos humanos sobre las interacciones en un contexto de redes

Crecimiento de la población humana en el mundo



Causas de amenaza y extinción

Figure 3.1 Major forces that threaten biological diversity. All arise from increases in human population and consumption levels, often mediated through our activities on the land and sea. Extinction and severe ecosystem degradation generally result from multiple impacts and from synergistic interactions among these threats.



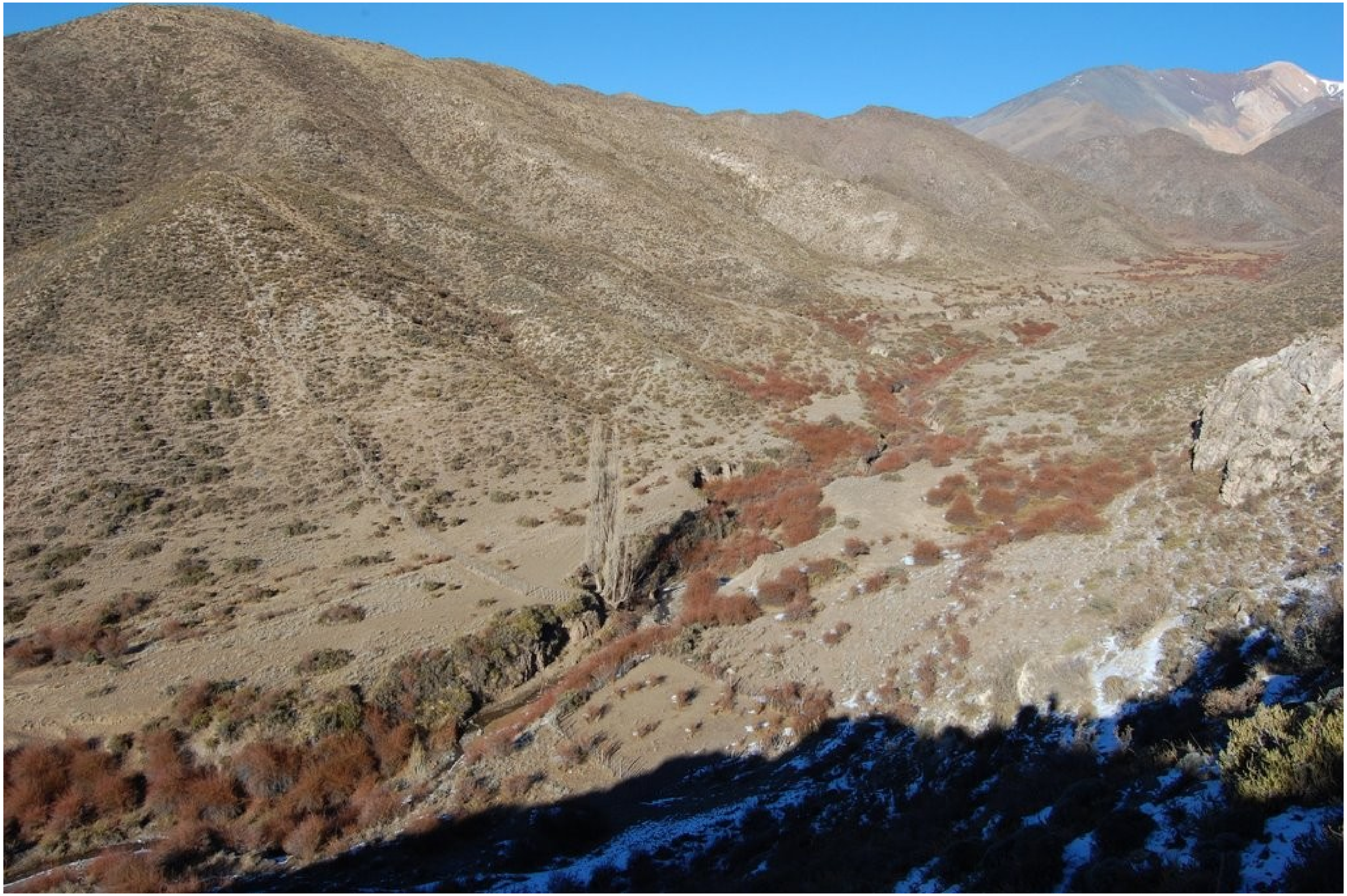
Destrucción y fragmentación del hábitat

Explotación de poblaciones

Fuego

Ganadería

Especies introducidas



Causas de amenaza y extinción

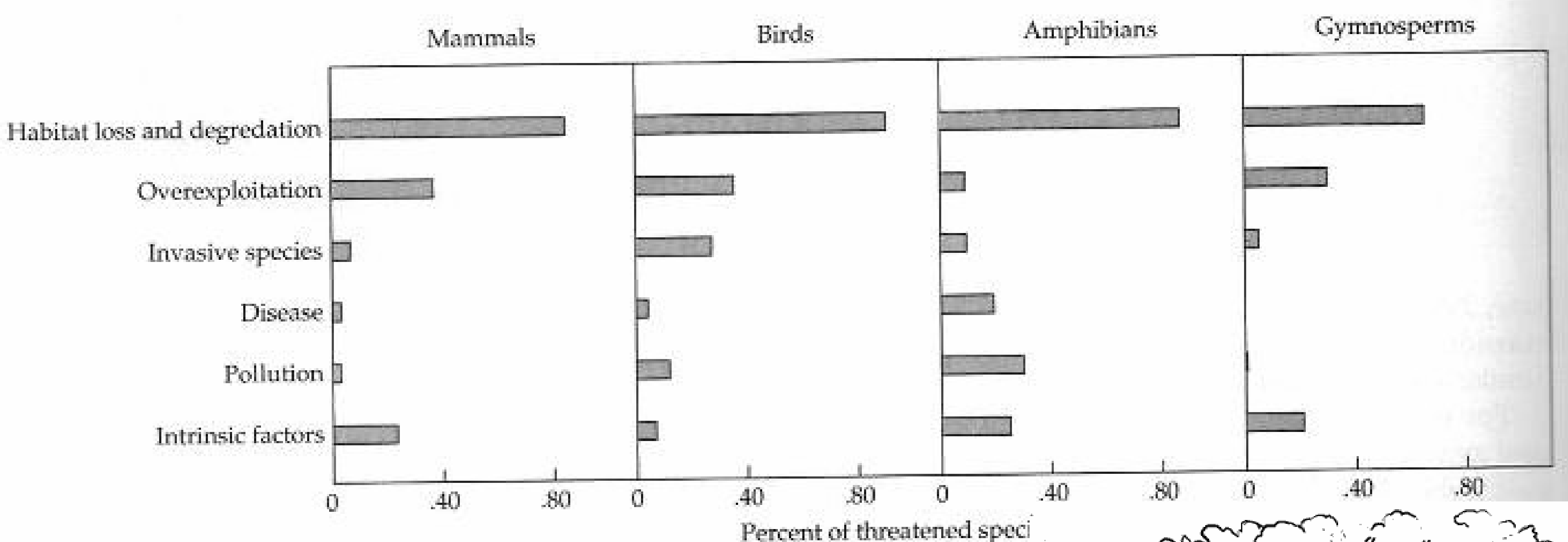
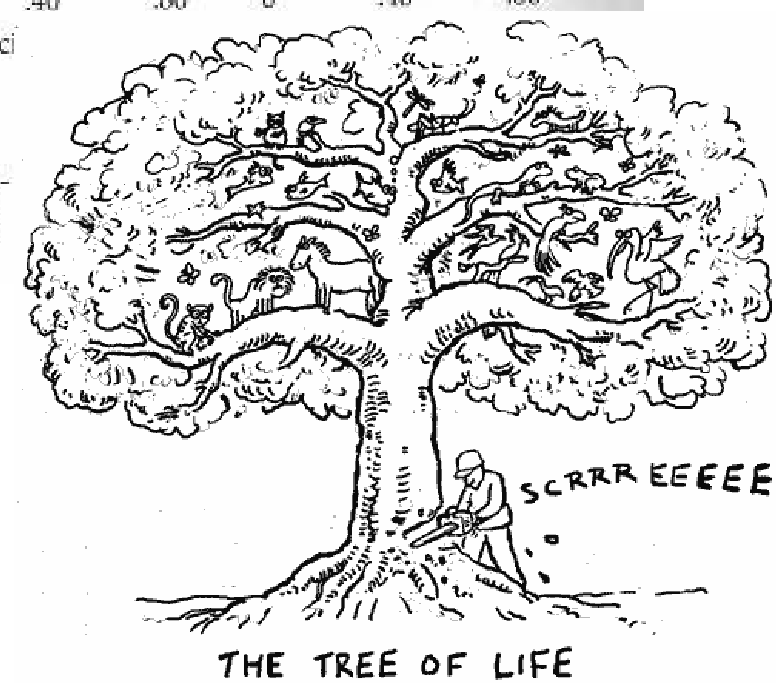


Figure 3.6 Habitat loss and degradation is the greatest threat to global biodiversity among mammals, birds, amphibians, and gymnosperms. Because not all threats are documented, this figure underestimates threat levels among Red Listed species. Overexploitation includes both direct mortality and by-catch. (Modified from IUCN 2004.)



Esquema de la charla

- Impactos humanos en los ecosistemas
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Table 9.1 Predicted effects of different disturbance types on the attributes of individual plants (floral display, flower morphology, rewards, flower physiology, and flowering phenology), plant populations (size, absolute density, and relative density) and plant communities (species diversity and composition).

	Individual					Population			Community	
Disturbance type	**Floral display**	**Flower morphology**	**Rewards**	**Flower physiology**	**Flower Phenology**	**Size**	**Absolute density**	**Relative density**	**Diversity**	**Composition**
Fragmentation	↑	?	↑	?	Δ	↓	↑↓	↑↓	↑↓	Δ
Fire	↑	?	↑	↑	Δ	↑↓	↑↓	↑↓	↑↓	Δ
Selective harvesting	0/↑	?	0/↑	?	0/Δ	↓	↓	↓	↑↓	Δ
Herbivores	↑↓	↓	↓	↓	Δ	↓	↓	↑↓	↑↓	Δ
Exotic plants	↓	?	↓	↓	Δ	↓	↓	↓	↑↓	Δ
Chemical agents	↓	↓	↓	↓	?	↓	↓	↑↓	↑↓	Δ

Table 9.2 Predicted effects of different disturbance types on the overall abundance, diversity, and composition of pollinator communities.

Disturbance type	**Abundance**	**Diversity**	**Composition**
Fragmentation	↑↓	↑↓	Δ
Fire	↑↓	↑↓	Δ
Selective harvesting	↑↓	↑↓	0/Δ
Herbivores	↑↓	↑↓	Δ
Exotic plants	↑↓	↑↓	Δ
Chemical agents	↓	↓	Δ

Aizen & Vázquez (2006) Em: Ecology and Evolution of Flowers, Oxford University Press, pp. 159-179

Table 9.3 Predicted effects of the individual, population, and community-level attributes of plants listed in Table 9.1 on pollination variables.

Attribute level	Attribute	Quantity	Quality	Purity
Individual	Floral display	↑	↑↓	↑
	Floral morphology	↑	↑↓	↑
	Rewards	↑	↑↓	↑
	Reproductive physiology	↑	↑	?
	Phenology	Δ	?	Δ
Population	Size	↑↓	↑	0
	Absolute density	↑↓	↑	0
	Relative density	↑	↑	↑
Community	Diversity	?	?	?
	Composition	?	?	?

Table 9.5 Predicted effects of pollination variables on quantitative and qualitative aspects of plant reproductive success.

Pollination attribute	Quantity	Quality
Quantity	↑	↑
Quality	↑	↑
Purity	↑	↑

Table 9.4 Predicted effects of the attributes of pollinator communities listed in Table 9.2 on pollination variables.

Attribute	Quantity	Quality	Purity
Abundance	↑	↑	0
Diversity	?	↑↓	↑↓
Composition	↑↓	↑↓	↑↓

Aizen & Vázquez (2006) Em: Ecology and Evolution of Flowers, Oxford University Press, pp. 159-179

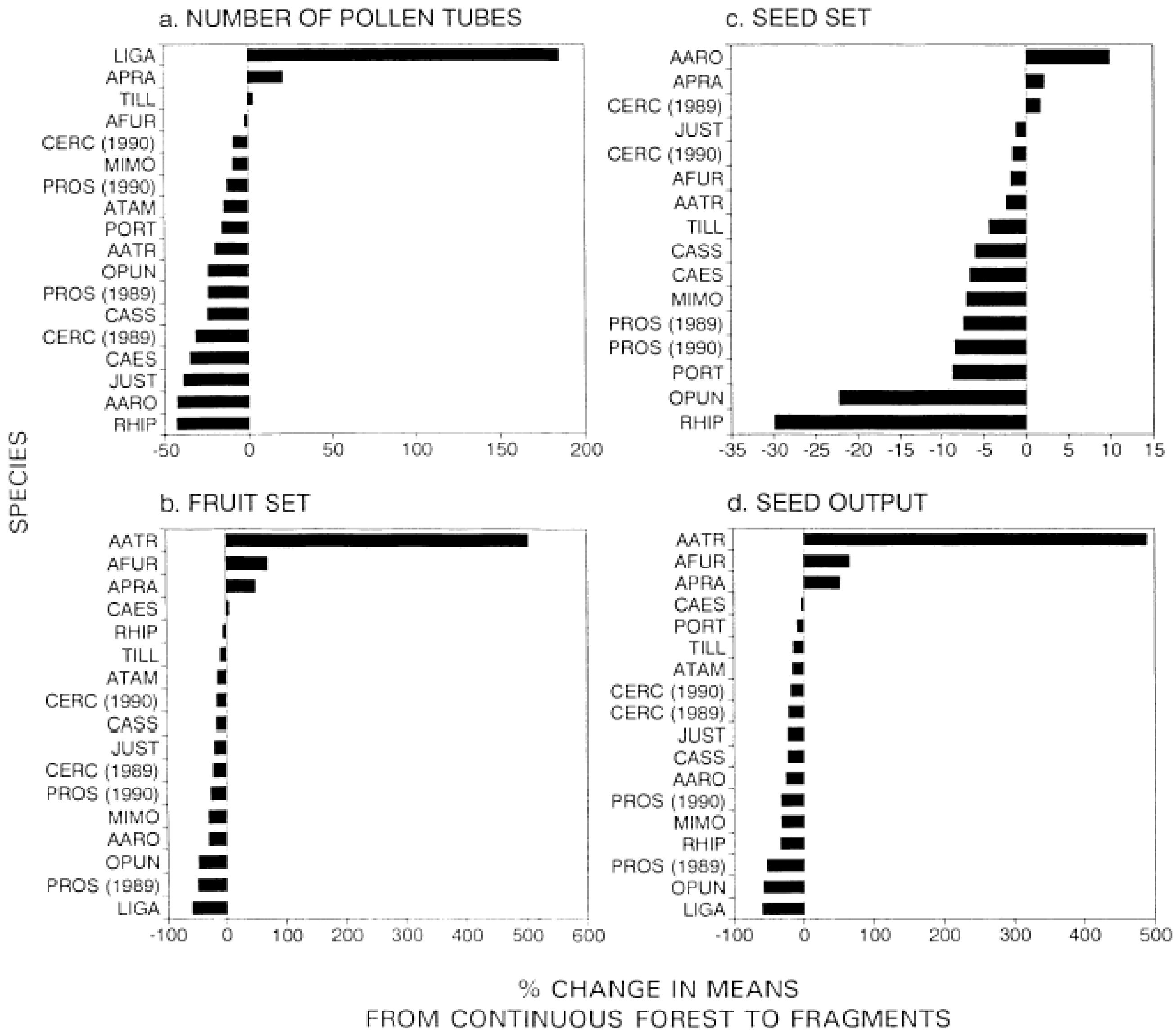


FIG. 2. Percent change from values in continuous forest to values in fragment habitat units (combined), ranked in descending order, for (a) mean number of pollen tubes (in *Portulaca* and *Justicia*, number of pollen grains), (b) fruit set, (c) seed set, and (d) seed output. Species codes are: AARO = *Acacia aroma*, AATR = *A. atramentaria*, AFUR = *A. furcatispina*, APRA = *A. praecox*, ATAM = *Atamisquea emarginata*, CAES = *Caesalpinia gilliesi*, CASS = *Cassia aphylla*, CERC = *Cercidium australe*, JUST = *Justicia squarrosa*, LIGA = *Ligaria cuneifolia*, MIMO = *Mimosa detinens*, OPUN = *Opuntia quimilo*, PORT = *Portulaca umbraticola*, PROS = *Prosopis nigra*, RHIP = *Rhipsalis lumbricoides*, TILL = *Tillandsia ixioides*.

Fuente: Aizen y Feinsinger (1994) *Ecology* 75: 330-351

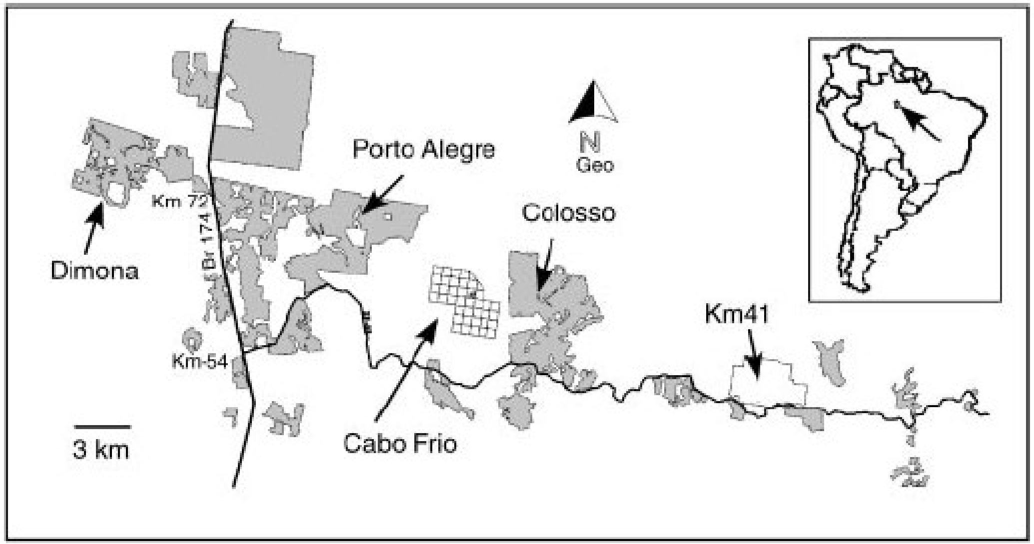


Fig. 1 Reserve system of the Biological Dynamics of Forest Fragments Project (2°30′S, 60°W). Adult *Dinizia excelsa* (≥ 40 cm d.b.h.) were mapped in the three ranches shown (shaded), and in continuous forest (unshaded) of Cabo Frio, Km41 and the Ducke reserve (not shown, located ~70 km to south). The embedded white squares represent forest fragments.

Fig. 2 *Dinizia excelsa* (foreground) left standing as a shade tree in a pasture landscape. This tree is Col.06 (see also Fig. 3). Cattle can be seen near the base of the tree.

Fuente: Dick et al. (2003) *Molec. Ecol.* 12: 753-764

Table 3 Diversity of microsatellite alleles in the *Dinizia excelsa* seed arrays

Maternal tree	Habitat	Seeds n	t_m	Locus DE27	DE37	DE44	DE48	DE54	Total alleles	Minimum sires
Col.06 '95'	Pasture	35	0.84	1	5	3	7	11	27	6
Col.06 '93'	Pasture	20	0.80	1	3	4	3	5	16	3
Col.07 '95'	Pasture	25	0.80	1	4	1	5	5	16	3
Col.07 '93'	Pasture	25	0.87	1	4	3	9	8	25	5
Col.08	Pasture	25	0.96	1	2	3	6	4*	16	3
Col.29	Pasture	25	0.80	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Col.13	Gallery	25	0.92	[illegible]	[illegible]	[illegible]	[illegible]	11	33	6
Col.18	10-ha	25	1.00	2	4	1	9	8	24	5
Col.26	10-ha	25	0.96	2	5	4	14	12	37	7
PA2.1	10-ha	8	1.0	0	1	1	3	4	9	2
PA2.2	10-ha	15	0.73	0	3	3	9	7	22	5
Dim1.1	1-ha	24	0.63	n/a	4	2	7	6	19	4
Duk 10	Forest	28	0.91	0	3	3	8	11	25	6
Duk.32	Forest	25	0.96	1	4	3	12	8	28	6
CF.26	Forest	25	1.00	1	4	0	7	5	17	4
41.03	Forest	14	0.93	0	6	4	4	2	16	3
41.05	Forest	24	1.00	0	2	2	8	9	21	5
41.09	Forest	24	0.96	1	5	2	9	7	24	5
41.13	Forest	25	0.90	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5
41.19	Forest	24	0.75	0	[illegible]	3	7	6	20	4
41.21	Forest	10	0.60	0	2	1	3	1	7	2
41.24	Forest	24	0.88	0	4	2	7	6	19	4
41.37	Forest	24	0.92	1	4	2	8	10	25	5
41.38	Forest	24	0.75	1	3	3	3	3	13	2
41.42	Forest	24	1.0	0	3	2	10	8	23	5
41.44	Forest	24	1.0	0	3	4	9	5	21	3

media = 0.856; polinizados principalmente por *A. mellifera*; disp. pollen ~1400 m

media = 0.897; polinizados principalmente por polinizadores nativos; disp. pollen ~200 m

t_m, multilocus outcrossing rate. The numbers below each locus indicate the number of unique paternal alleles in the seed array, summed across loci under 'Total alleles' (see text). Seed arrays are from the 1995 flowering, except for Col.06 '93' and Col.07 '93' which are from 1993. Canopy observations were made on the trees indicated in italics. *Sample < 10 seeds.

Fuente: Dick et al. (2003) *Molec. Ecol.* 12: 753-764

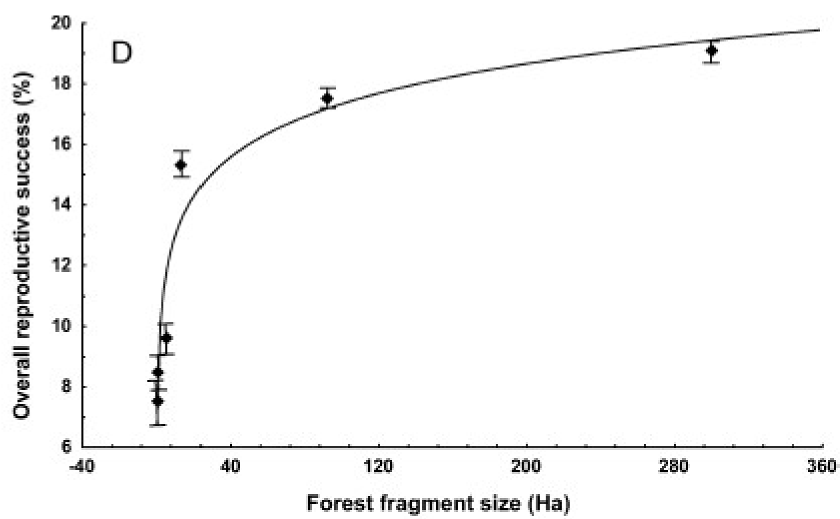
Table 1 Gradient of fragment sizes of a Chaco Serrano forest in central Argentina

Forest fragment	Area (ha)	Distance to nearest forest fragment (km)	Matrix characteristic
A	0.40	0.5	Soybean crop and highway verge
B	1.20	0.7	Soybean crop
C	5.30	0.5	Soybean crop and road verge
D	13.60	0.6	Corn and soybean crops
E	92.10	0.5	Corn crop and highway verge
F	>300	–	Natural reserve

Table 3 Results of univariate ANOVAs (*F* -ratios) of forest fragments and conspecific density effects

Effect	*df*	Pollen removal	Pollen load	Pollen tubes	Fruit-set	Seed-set	ORS
Forest fragment size	2	0.514	14.941**	29.356**	0.058	8.907**	3.371**
Conspecific density (Forest fragment size)	9	0.645	0.675	0.394	0.445	0.275	0.497
Error	29						

** $P < 0.01$



Fuente: Aguilar y Galetto (2004) *Oecologia* 138: 513-520

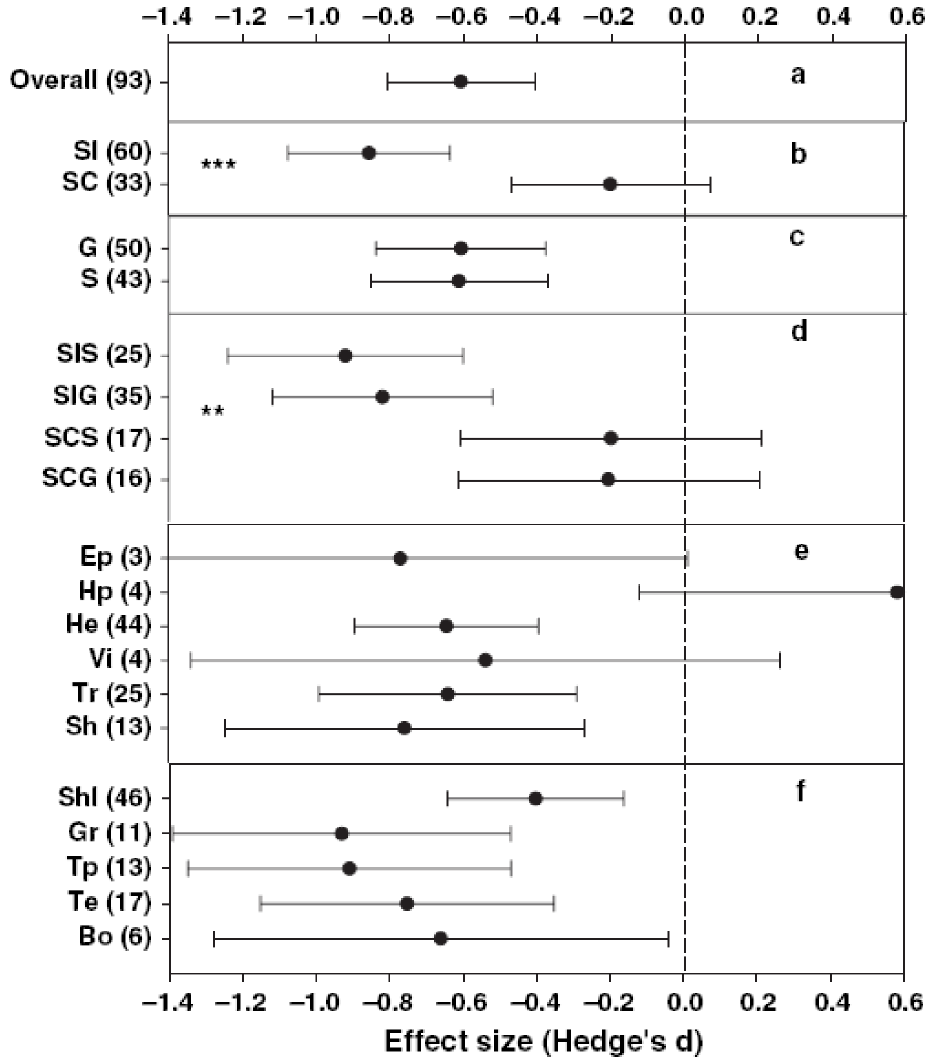


Figure 2 Weighted-mean effect sizes and 95% bias-corrected confidence intervals of habitat fragmentation on plant reproduction for the whole sample of species (a), and categorized by their compatibility systems (b), pollination specialization (c), the combination of both, compatibility systems and pollination specialization (d), life forms (e) and habitat types (f). Sample sizes for each categories are shown in parentheses; dotted line shows Hedge's $d = 0$. Abbreviations are as specified in Figure 1. Significance levels associated with Q-values: $^{***}P < 0.001$; $^{**}P < 0.05$.

Fuente: Aguilar et al. (2006)
Ecol. Lett. 9: 968-980

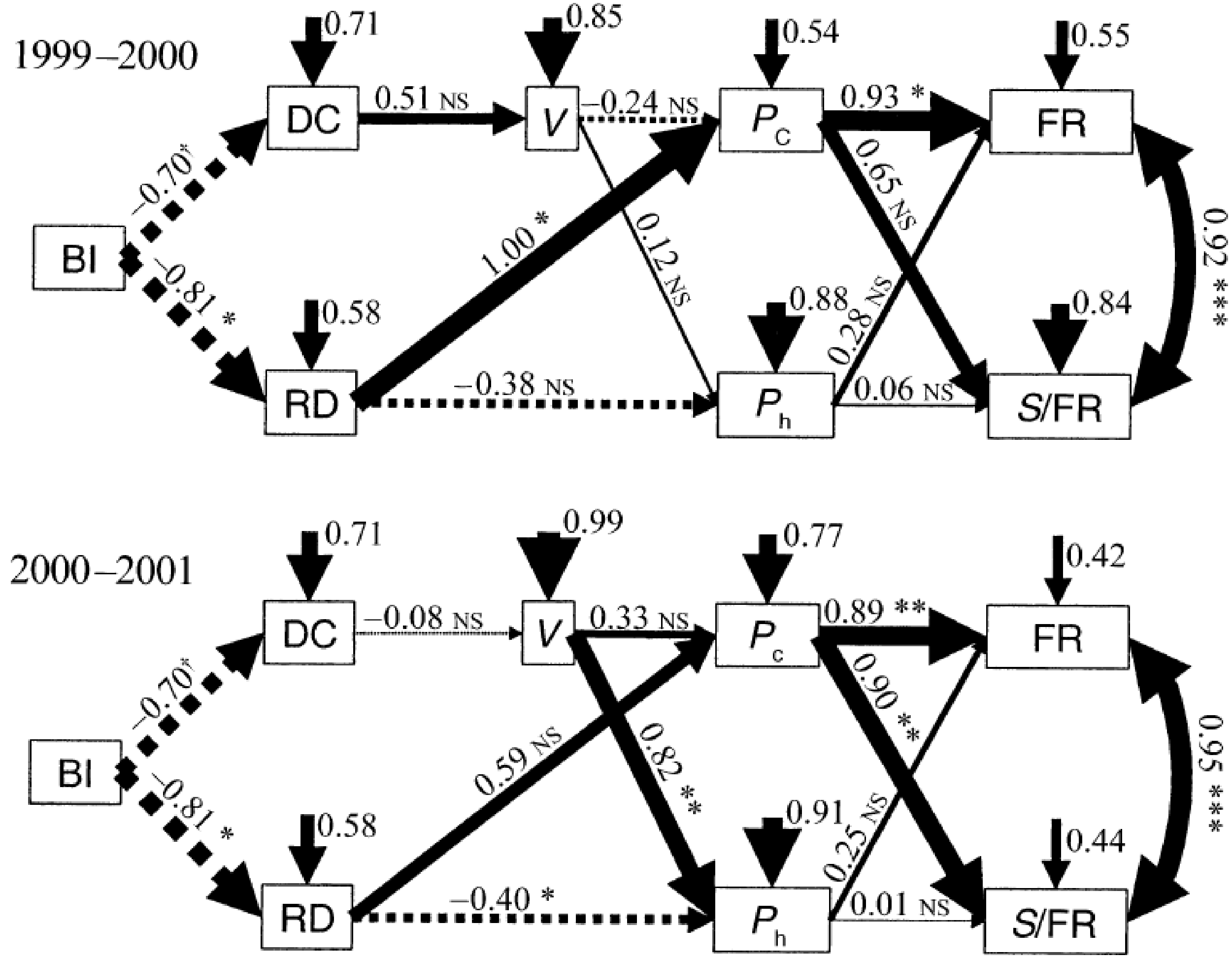


FIG. 11. Among-site path analysis of causal relationship among variables hypothesized to be involved in indirect effects of cattle on *Alstroemeria aurea* pollination and reproduction. One-headed arrows represent direct causal effects; two-headed arrows represent correlational effects. For each effect path, coefficients are given and are also represented by arrow line-thickness. Continuous lines indicate positive effects; dashed lines indicate negative effects. Significance of the path coefficients is indicated as follows: $\dagger P < 0.1$; $*P < 0.05$; $**P < 0.01$. Data for browsing and density are from the 1999–2000 period and assumed to be the same for 2000–2001 (see *Methods*). See Appendix J for covariance matrix. Variables included in the model are: browsing index (BI); absolute (DC) and relative (RD) plant population density; pollinator visitation frequency (V); conspecific (P_c) and heterospecific (P_h) pollen deposition; fruits per flower (FR); and seeds per fruit (S/FR). Unexplained variability is indicated with vertical arrows above each endogenous variable.

Vázquez & Simberloff (2004) Ecol. Monogr. 74: 281-308

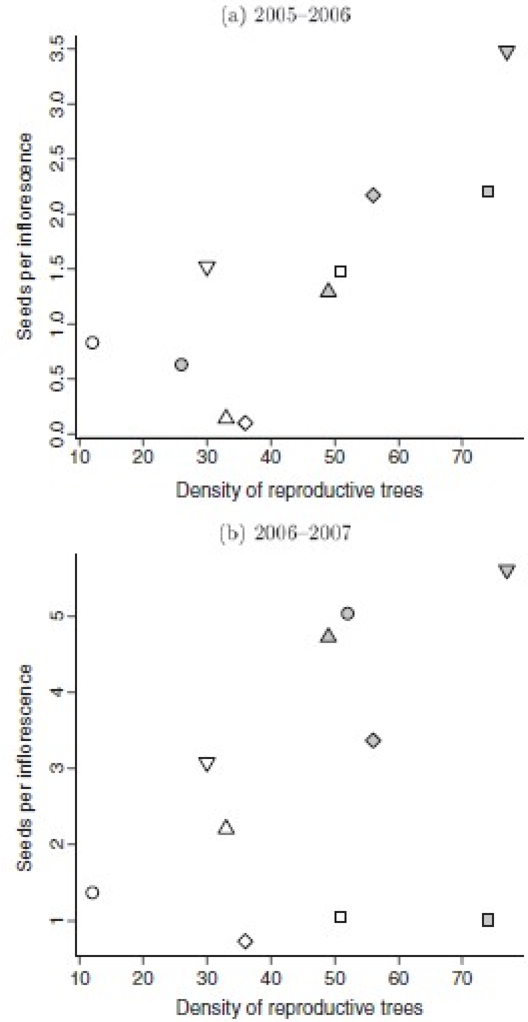


Fig. 1. Relationship between seeds per inflorescence and density of adult trees (number of trees in 4000 m²) at each study plot. White symbols indicate cattle grazed plots, grey symbols reserve plots. The plot relocated in 2006 is labeled with a grey circle. Linear model fit: (i) 2005–2006: $r = 0.59$, $P = 0.03$; and (ii) 2006–2007: $r = 0.20$, $P = 0.24$.

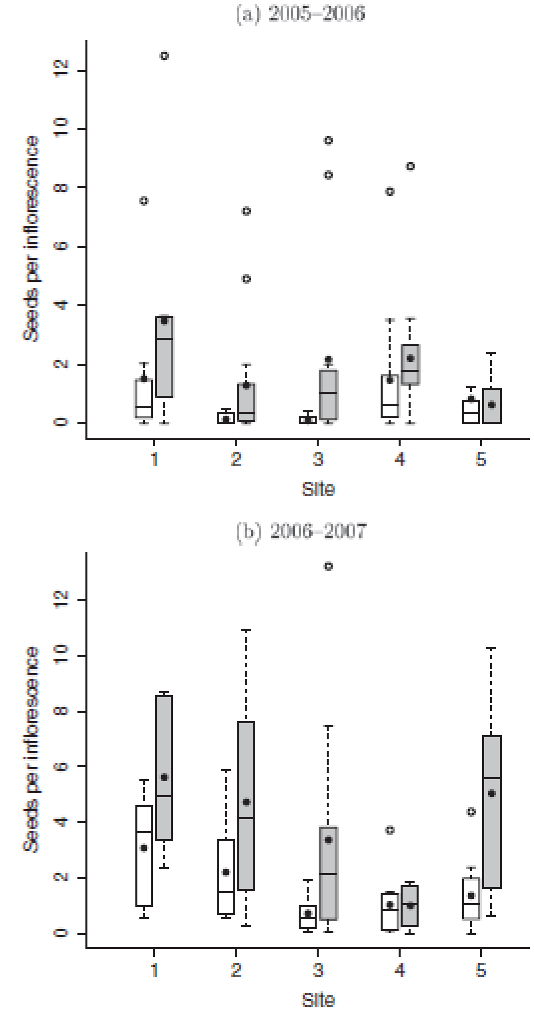


Fig. 3. Comparisons of seeds per inflorescence at each pair of protected and grazed plots during (i) 2005–2006; and (ii) 2006–2007. Seeds per inflorescence was higher in protected plots ($z = 2.78$, $P = 0.0053$). Box plots as in Fig. 2.

Aschero & Vázquez (2009) Austr. Ecol.

Esquema de la charla

- Impactos humanos en los ecosistemas
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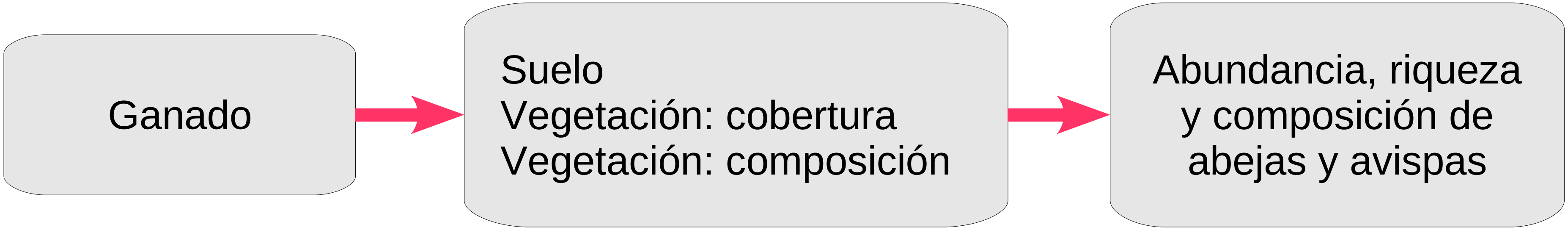
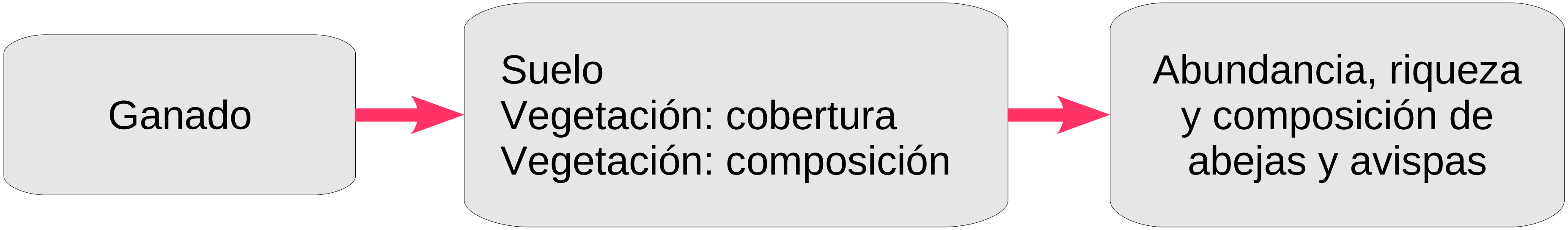
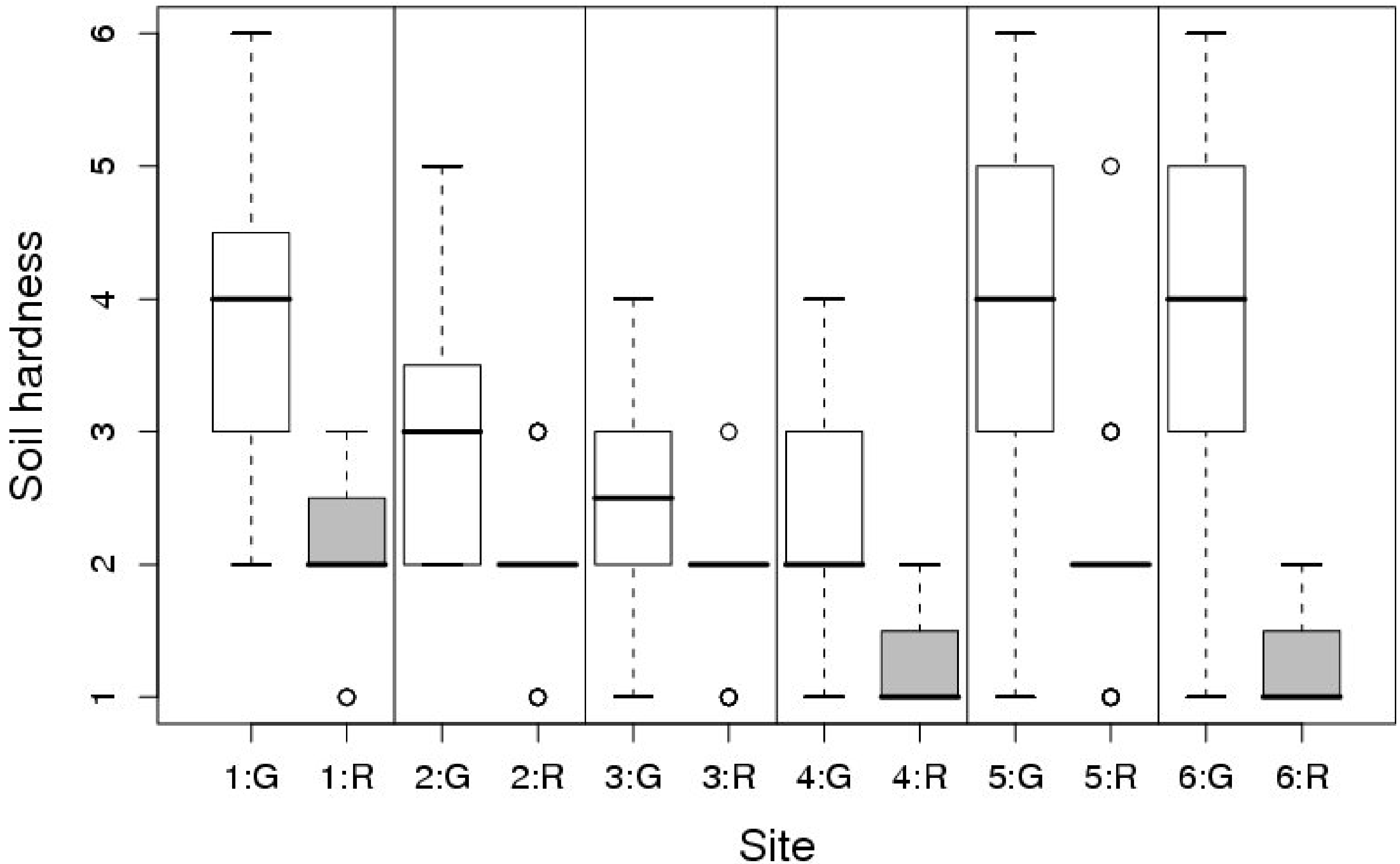
- Efeitos humanos sobre las interacciones en un contexto de redes


nacunan, mendoza, argentina



Vázquez et al. (2008) Rev. Soc. Ent. Arg. 67: 1-10





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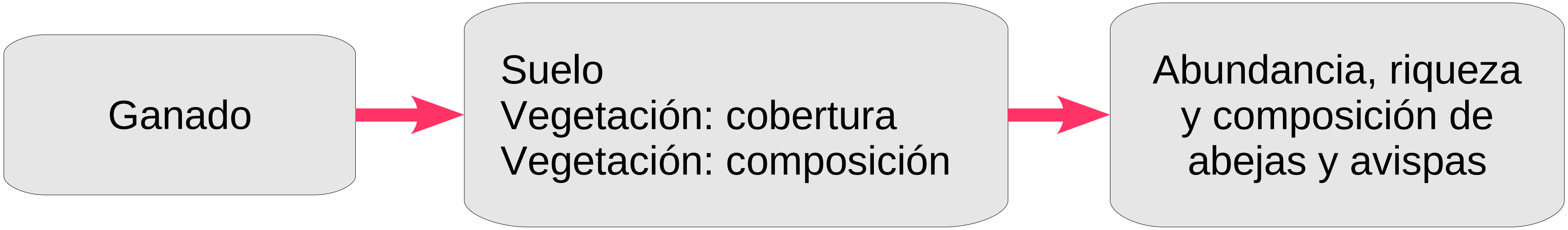
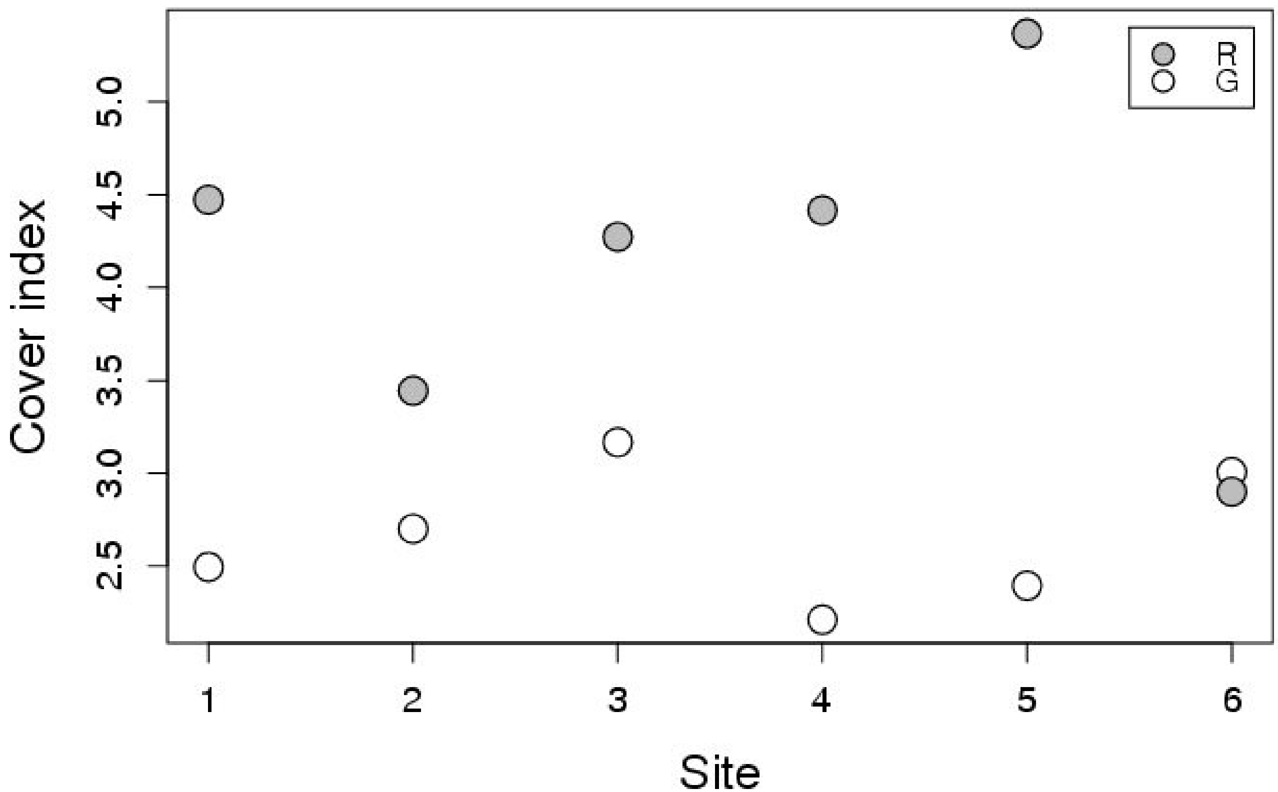
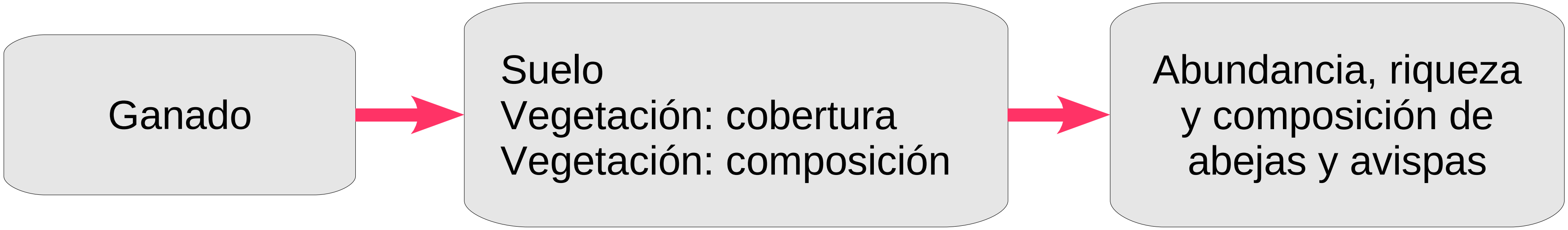
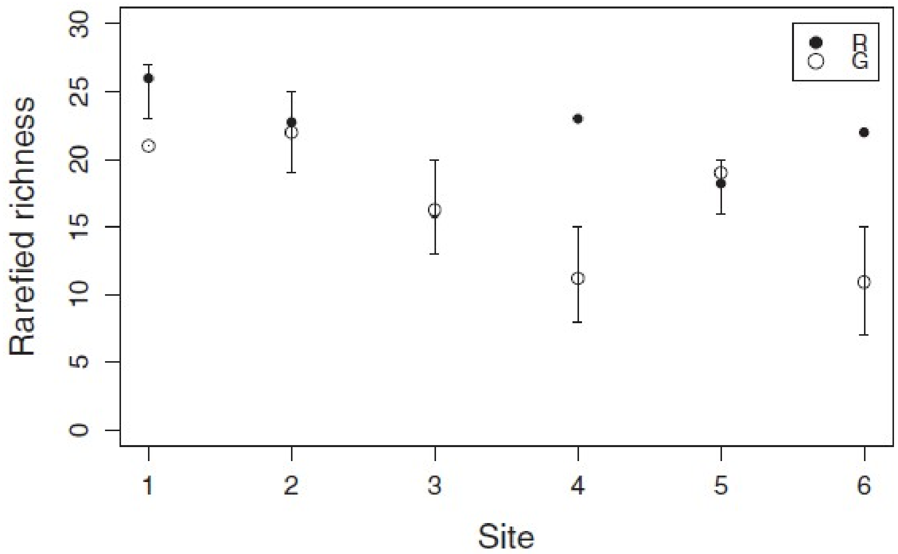




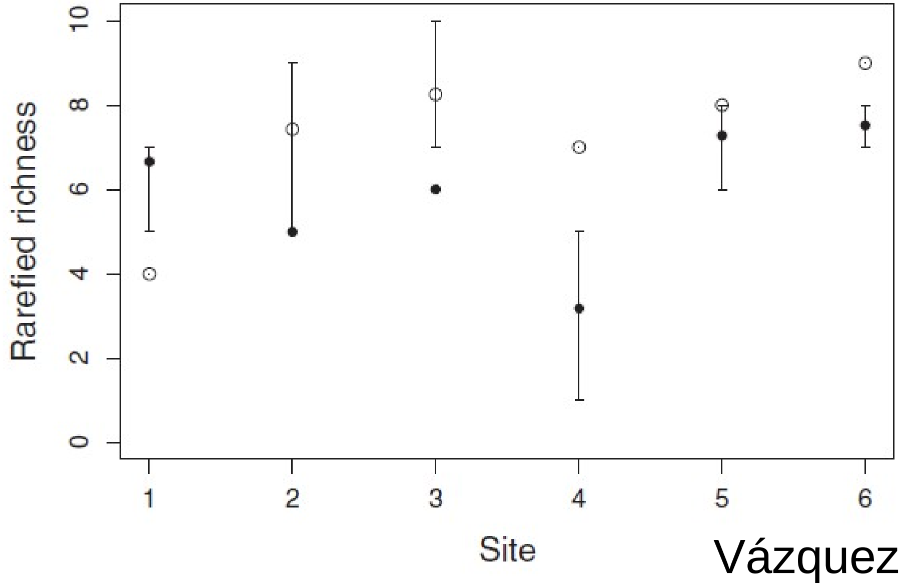
Vázquez et al. (2008) Rev. Soc. Ent. Arg. 67: 1-10



(a)



(b)



Vázquez et al. (2008) Rev. Soc. Ent. Arg. 67: 1-10

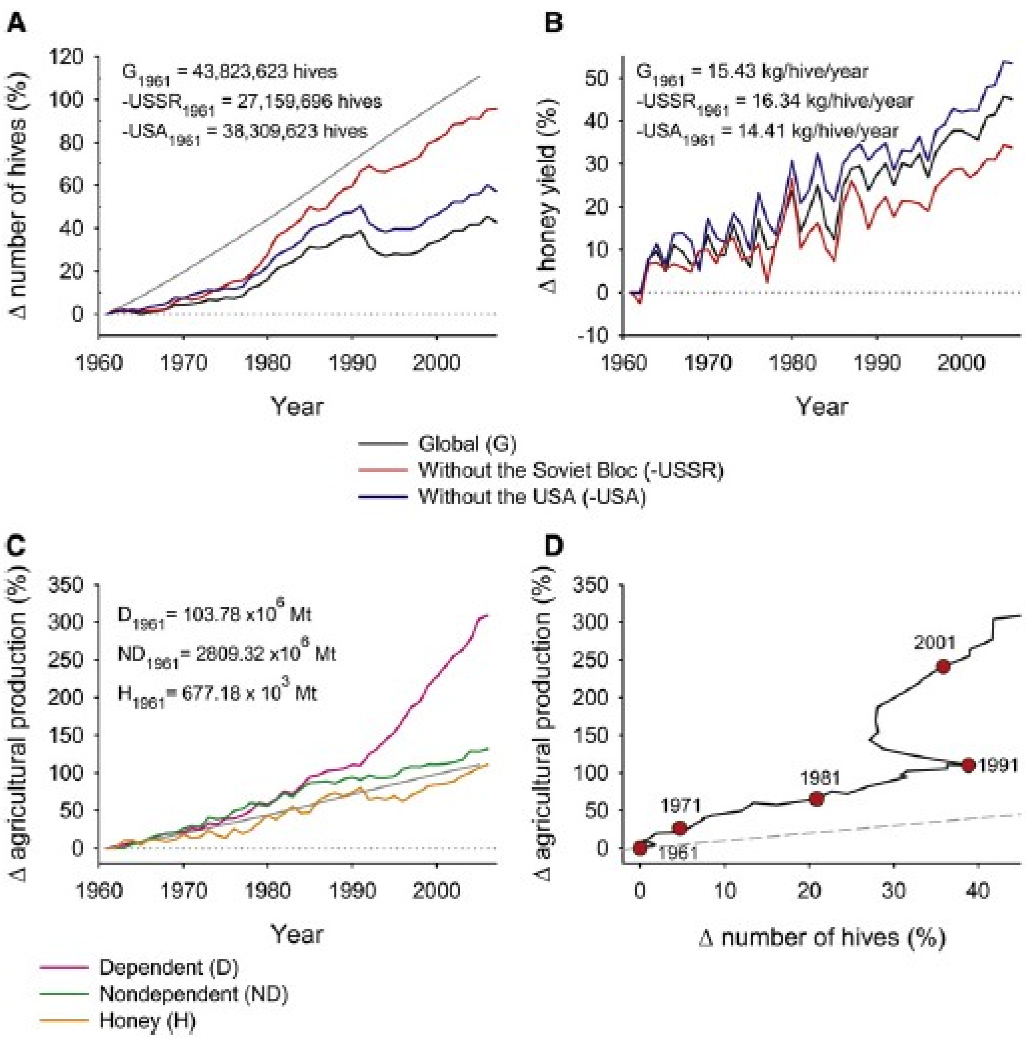
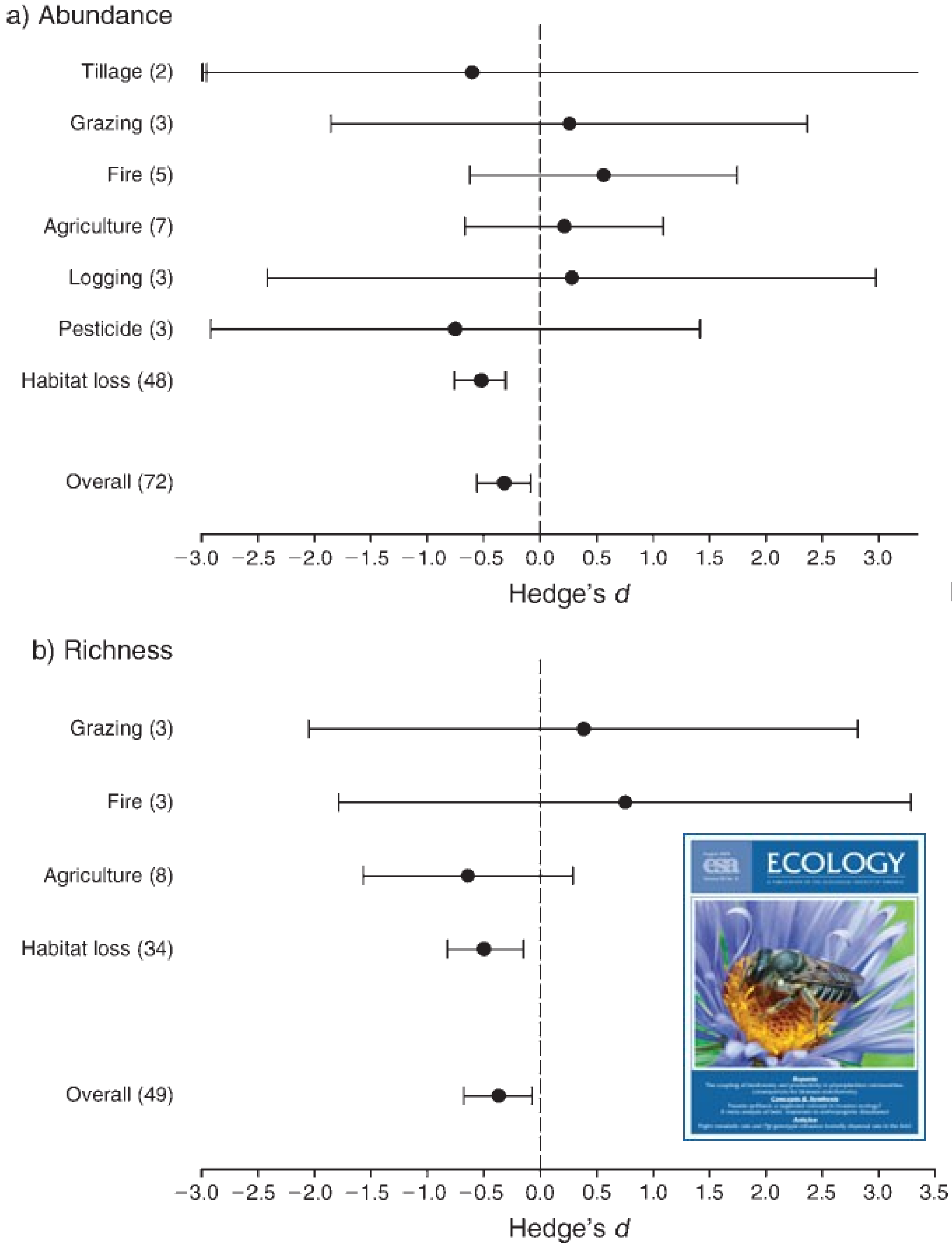
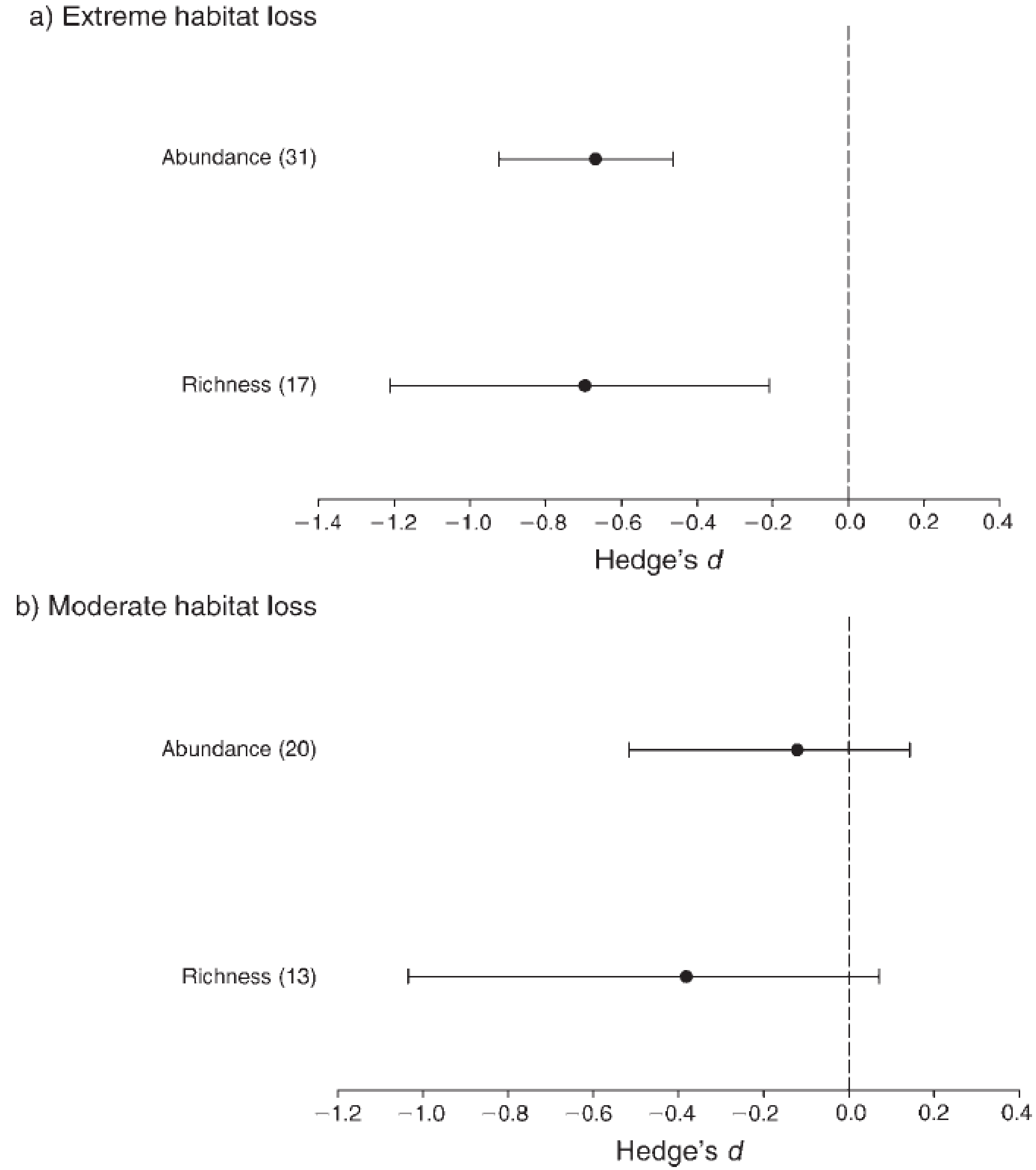


Figure 1. Changes in Global Numbers of Honey-Bee Hives, Agricultural Production, and Human Population between 1961 and 2007

(A–D) Change (Δ) for variable *x* from 1961 until year *t* is represented as a percentage of the value of *x* during 1961, x_{1961}, which is presented numerically for (A) number of hives, (B) honey yield, and (C) agricultural production. The figure demonstrates that the global number of commercial honey-bee hives, as reported by the Food and Agriculture Organization of the United Nations, has increased since 1961, despite a brief decline during the early 1990s mostly related to the dissolution of the Soviet Bloc (A). Notwithstanding this decline, efficiency in honey yield (i.e., annual production per hive) increased during the last five decades (B). Production of honey and the > 90% of agricultural production that is independent of animal pollination (C) increased at a rate similar to that of the global human population growth (gray line in [A] and [C]). However, the growth in the fraction of agricultural production that requires the service of animal pollinators increased disproportionately since 1991, after economic globalization and the implementation of market economies in the former Soviet Bloc and China (C). The growth in the fraction of agricultural production that depends on pollinators outpaced the growth of the global stock of domesticated honey bees (D), as indicated by the elevation of the trajectory above the dashed gray line representing equal growth rates. Any possible link between growth rates of pollinator-dependent agriculture production and abundance of managed honey bees decoupled abruptly in 1991.

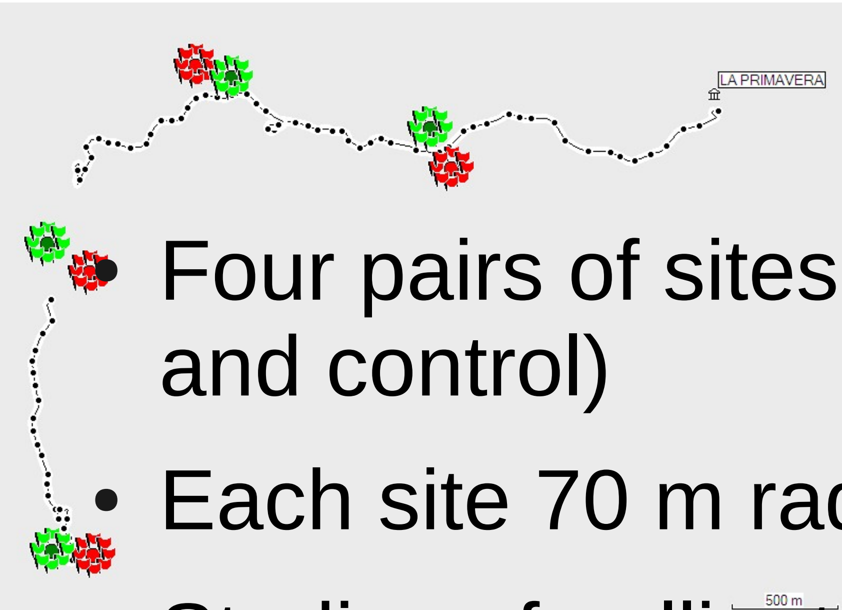
Aizen & Harder (2009) Current Biology 19: 1-4



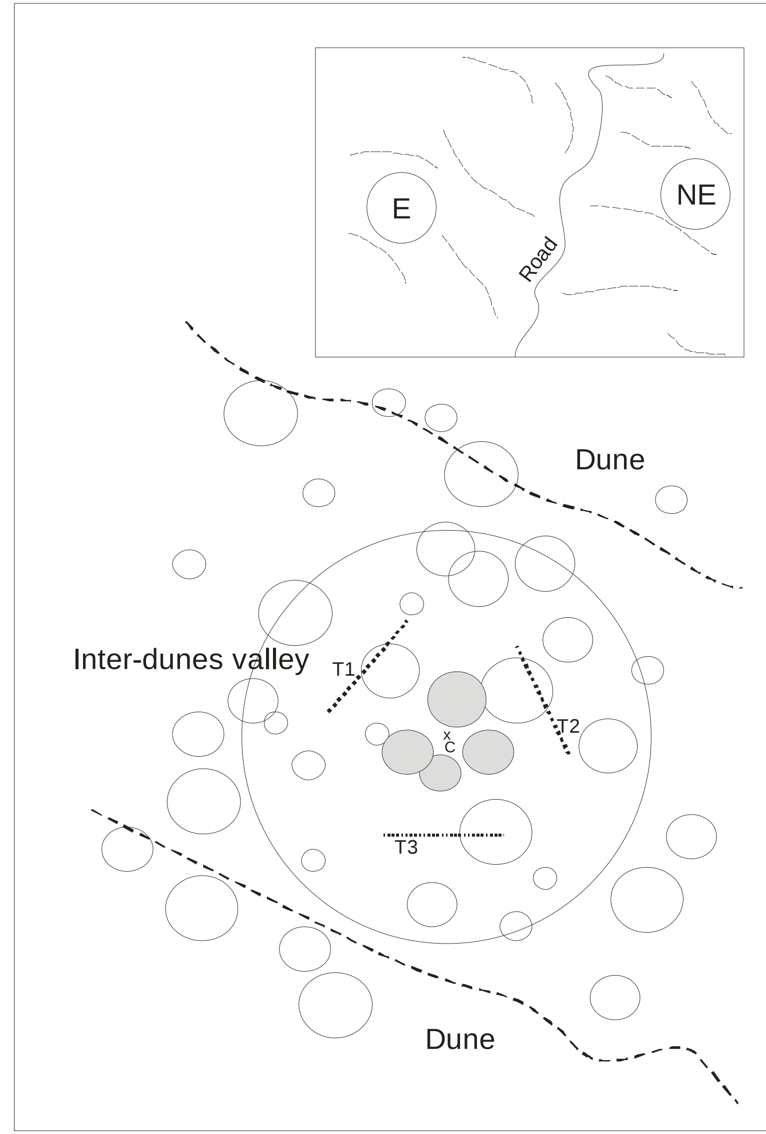


Winfree et al. (2009) Ecology 90: 2068-2076

Study design

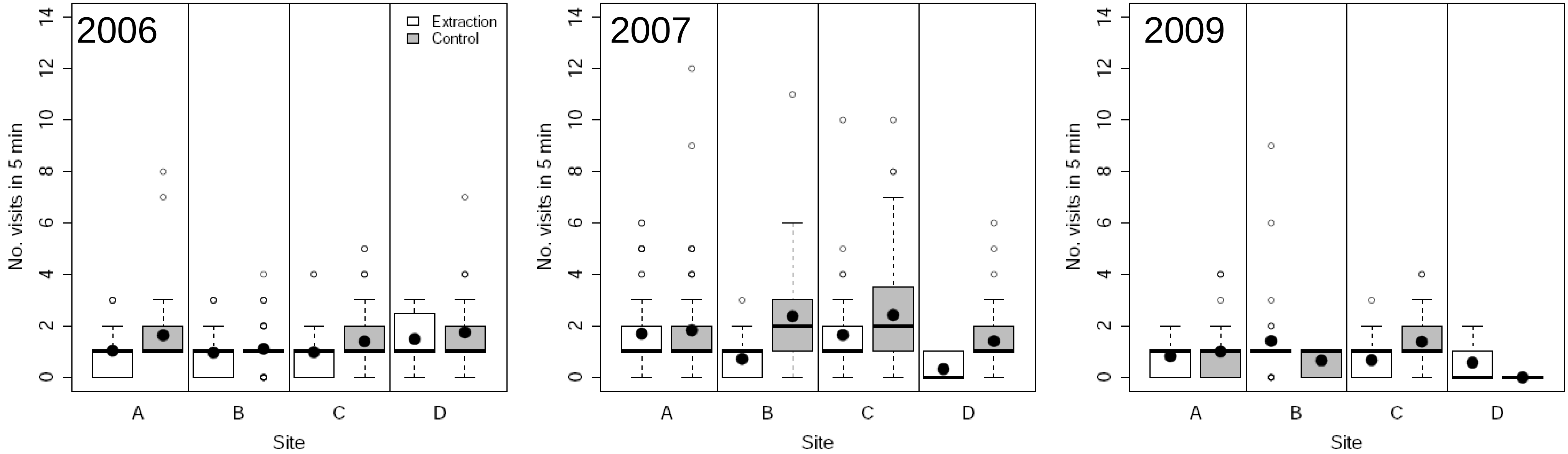


- Four pairs of sites (extraction and control)
- Each site 70 m radius
- Studies of pollinator visits, seed production of *P. flexuosa*, soil properties and understory vegetation

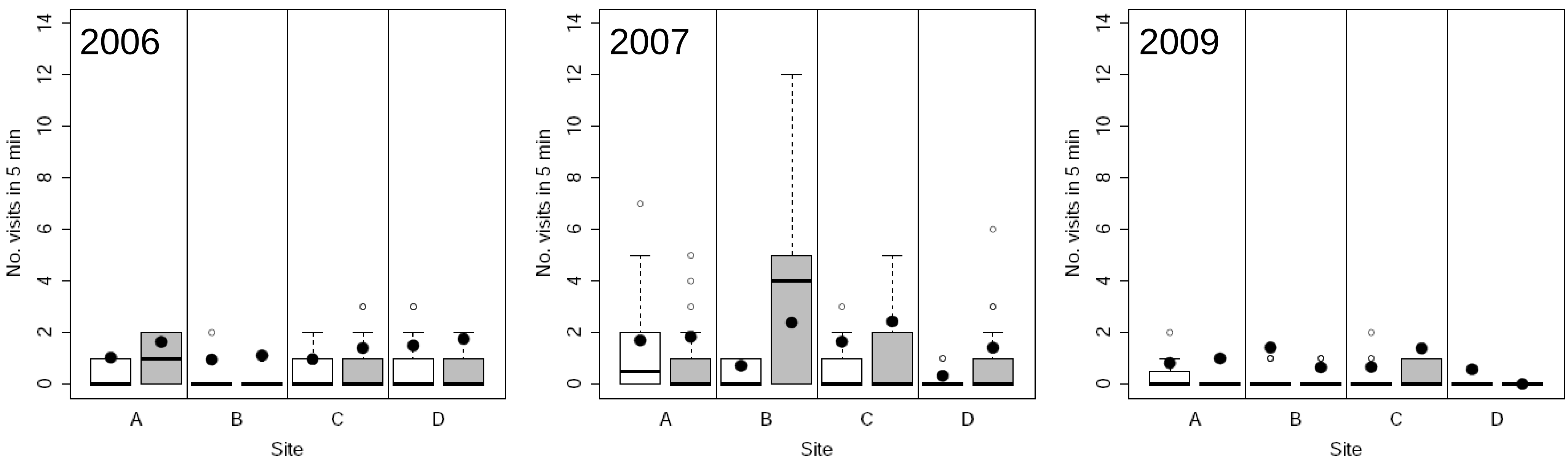


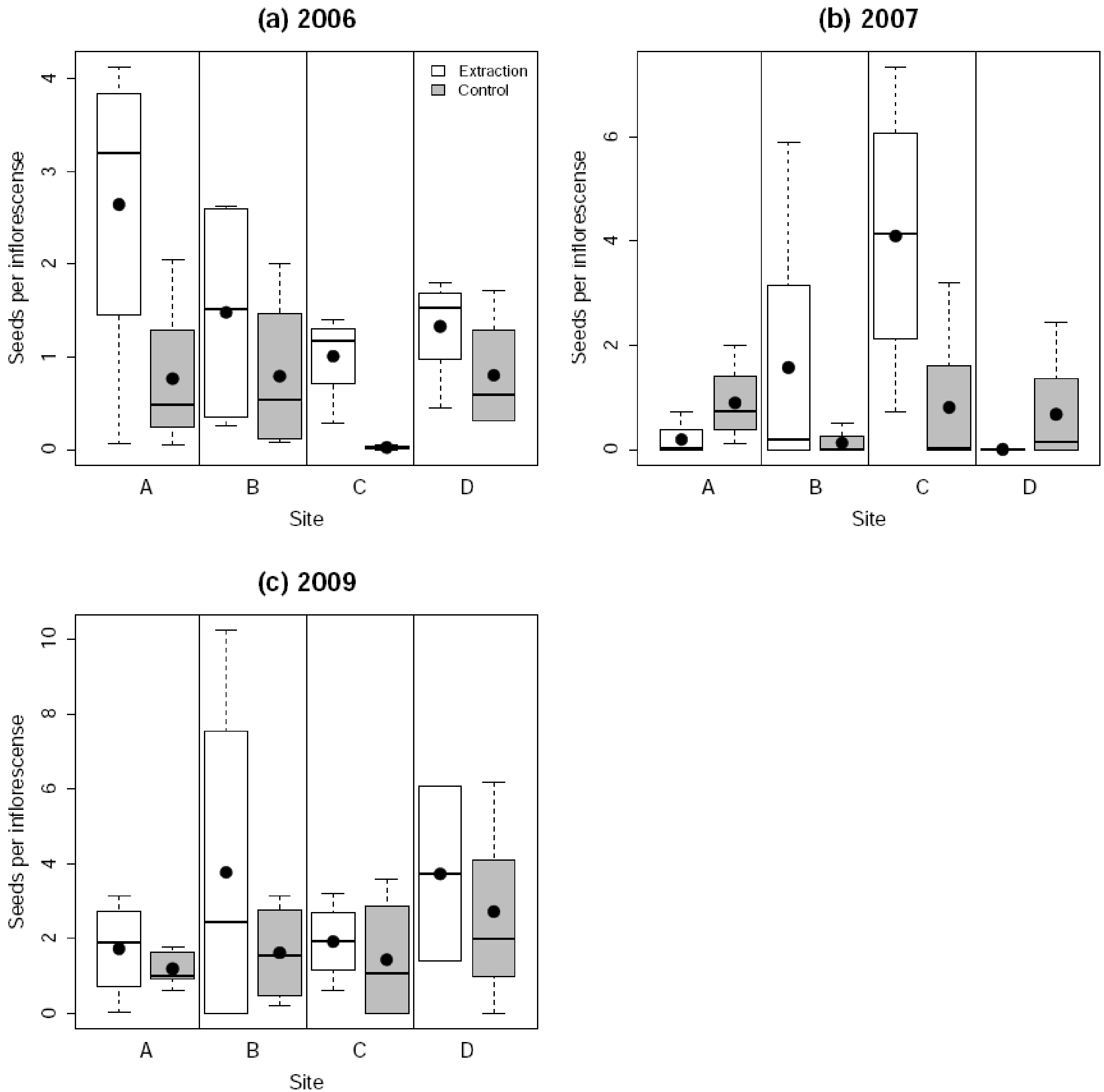
Vázquez et al., ms. enviado

All flower visitors



Wood-nesting bees only





Vázquez et al., ms. enviado

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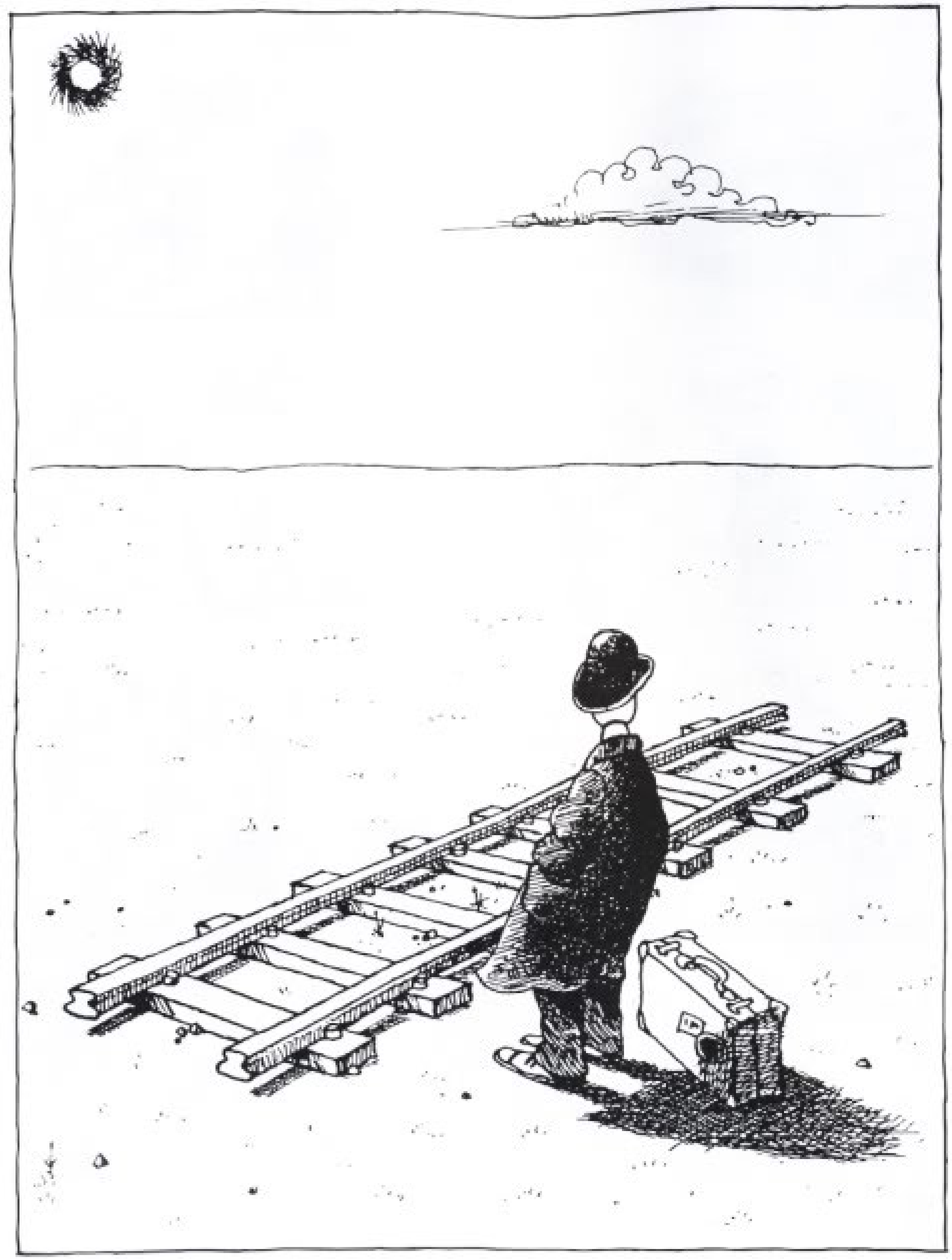


Extinciones y estabilidad de las redes

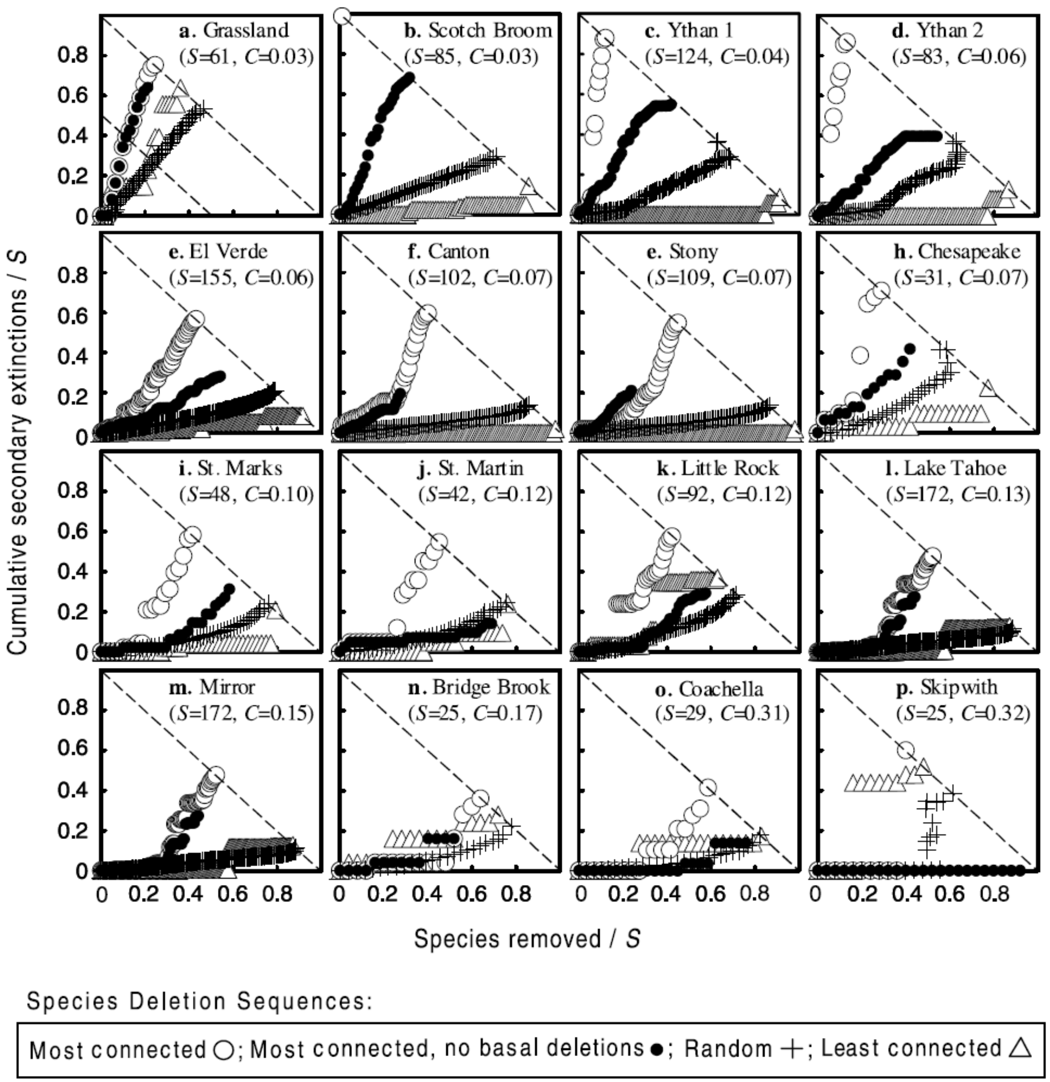


Figure 1 Secondary extinctions resulting from primary species loss in 16 food webs ordered by increasing connectance (C). 95% error bars for the random removals fall within the size of the symbols and are not shown. For the most connected, least connected, and random removal sequences, the data series end at the diagonal dashed line, where primary removals plus secondary extinctions equal S and the web disappears. For the most connected species removals with basal species preserved, the data points end when only basal species remain. The shorter diagonal dashed line in Fig. 1(a) shows the points at which 50% of species are lost through combined removals and secondary extinctions ('robustness' of Fig. 2).

Fuente: Dunne et al. (2002) *Ecol. Lett.* 5: 558-567

Extinciones y estabilidad de las redes

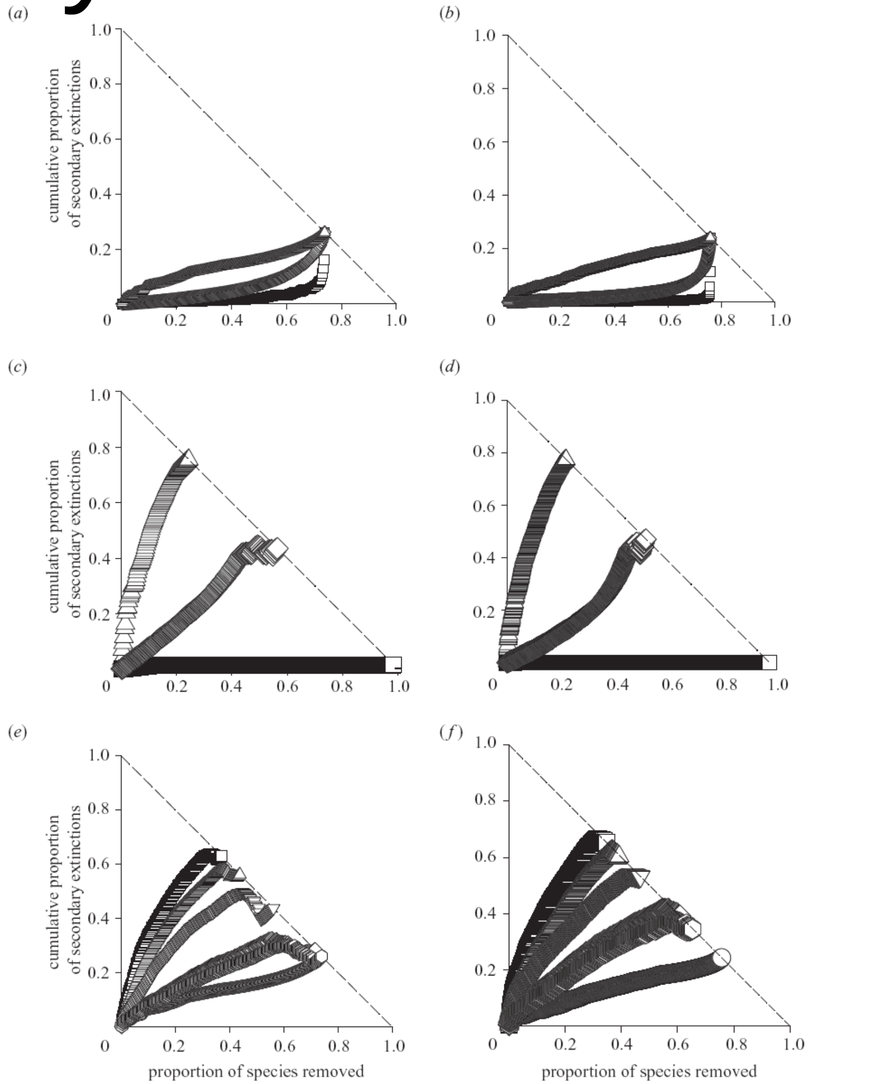


Figure 4. Proportion of species lost to secondary extinctions as a function of proportion of species removed (primary extinction) from C&L (left) and R (right). The diagonal dashed lines connect points at which all species in the network are lost, triangles = most-connected species removed first, squares = least-connected removed first, diamonds = random removal. In (*a*) and (*b*) pollinators alone are removed, and secondary extinctions are solely of plants (these are the same data as in figure 1, in different form). In (*c*) and (*d*) plants and pollinators are equally at risk of being removed. Intermediate cases (*e*,*f*) in which plants experience non-zero risk of primary extinction, but lower risk than for pollinators; only removal of most-connected species first is shown in these figures. Each curve in (*e*,*f*) represents the average of 300 replicate simulations, the error bars are smaller than the symbols and are not shown. Moving from the uppermost to lowermost curve in (*e*,*f*) represents the pollinators having twice the extinction risk, five times the risk, 10 times the risk, 40 times the risk, and 60 times the risk of the plants. Some curves dip downwards as they approach the diagonal as not all of the replicate simulations persist equally long before the whole pollination web becomes extinct. Those that persist longest have slower accumulation of secondary extinctions, so the mean of the cumulative secondary extinctions tends to be lower towards the end.

Fuente: Memmott et al. (2004) Proc. R. Soc. B 271: 2605-2611

Extinciones y estabilidad de las redes

Table 1. Characteristics of eight complete plant-pollinator communities located in NW Patagonia, Argentina. For further details see Devoto et al. (2005). Degree of nestedness was measured using Aninhado software (Guimarães and Guimarães 2006).

Tabla 1. Características de ocho redes planta-polinizador completas localizadas en el NO de Patagonia, Argentina. Ver Devoto et al. (2005) para más detalles. El grado de anidamiento fue medido con el programa Aninhado (Guimarães y Guimarães 2006).

Site (abbreviation)	Lago Queñi (LQ)	Paso Puyehue (PP)	Lago Tromen (LT)	Arroyo Pedregoso (AP)	Villa Traful (VT)	Lago Huechulaf-quen (LH)	La Lipela (LL)	Confluencia Traful (CT)
Geographic coordinates	S 40° 09′ W 71° 43′	S 40° 44′ W 71° 53′	S 39° 34′ W 71° 26′	S 40° 37′ W 71° 35′	S 40° 39′ W 71° 21′	S 39° 48′ W 71° 12′	S 40° 48′ W 71° 6′	S 40° 43′ W 71° 05′
Mean annual precipitation (mm)	2550	2000	1750	1700	1250	1050	750	700
Altitude (m.a.s.l.)	800	950	1000	872	900	780	735	727
No. of flower visitors	113	38	111	48	81	101	116	114
No. of plants	23	17	23	16	28	29	33	21
Degree of nestedness	4.94	13.58	3.71	16.09	11.72	4.47	4.51	14.6

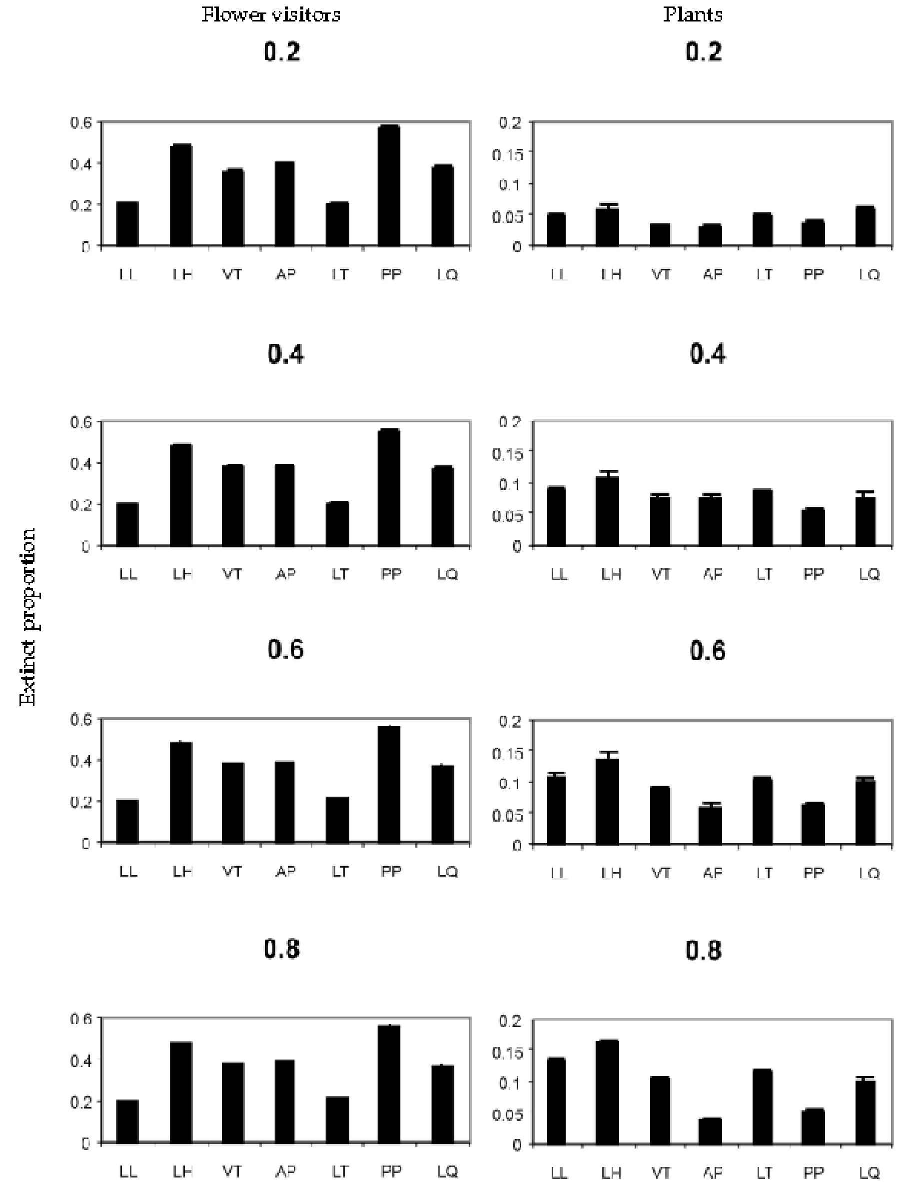
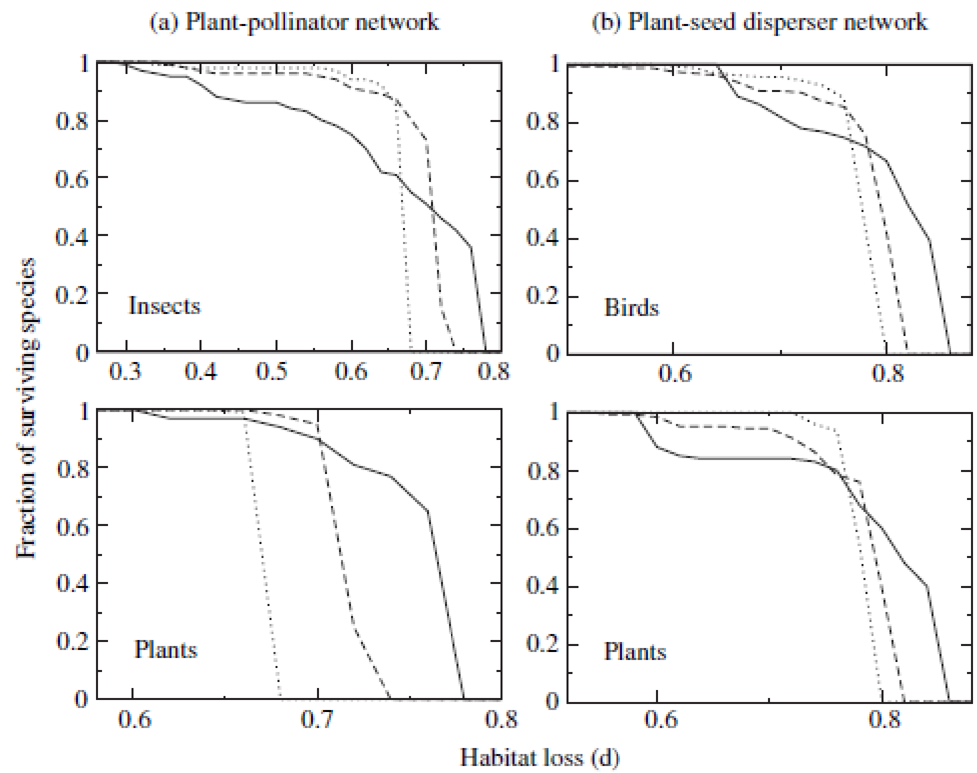


Figure 1. Proportion (mean ± SE) of flower visitors (left) and plants (right) "extinct" (i.e. left without mutualists) as a function of the migration of different proportions (0.2-0.8, indicated above each graph) of flower visitors (n = 100 randomizations).

Fuente: Devoto et al. (2007) Ecol. Austr. 17: 37-50

Extinciones y estabilidad de las redes

Figure 4 Effect of habitat loss (d) on the fraction of species surviving for the real network (solid line; average of 10 replicates), and the randomizations using null model 1 (dotted line; average of 10 replicates), and null model 2 (broken line; average of 10 replicates), for both the plant-pollinator network (a), and the plant seed disperser network (b). Inset names indicate the taxa represented. Parameters for each species are again sampled from a uniform distribution with mean $e_{p_i}/c_{p_i} = e_{a_j}/c_{a_j} = 0.5$ and 10% of variance for the plant pollinator network, and mean $e_{p_i}/c_{p_i} = e_{a_j}/c_{a_j} = 0.25$ and 10% of variance for the plant seed disperser network.



Fuente: Fortuna & Bascompte (2006) Ecol. Lett. 9: 281-286

Extinciones y estabilidad de las redes

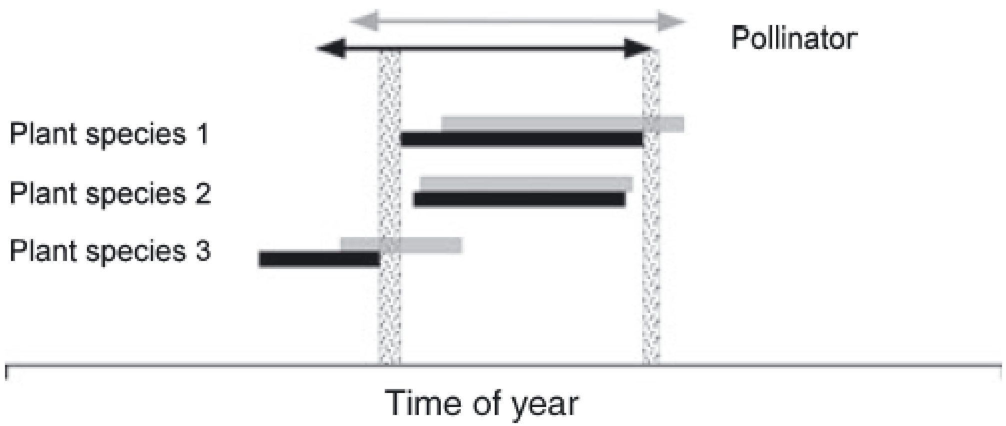


Figure 2 Hypothetical example of shifted phenologies of plants and a shared pollinator that lead to the pollinator experiencing a gap in its food supply and a curtailment in supply at the end of its period of flight activity. The three plant species have been shifted forward (i.e. to the left on the graph) in timing of their flowering (thick black horizontal lines) relative to their ancestral timing (shaded lines), and the pollinator also has shifted (black two-headed arrow vs. shaded arrow). These shifts have produced a gap in food supply (stippled column to left of figure) and a curtailment at the end of the pollinator's flight season (stippled column to right).

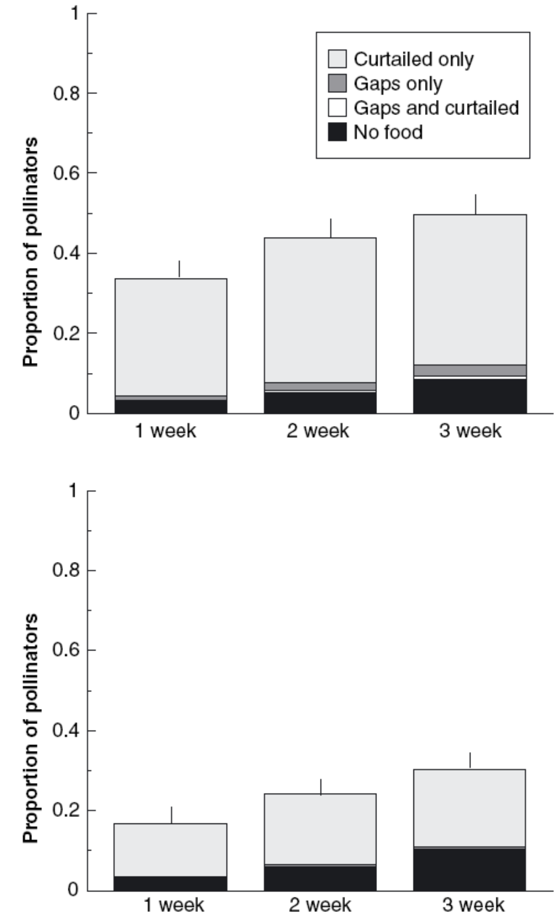


Figure 3 Frequencies of alternative types of food disruption resulting from 1-, 2- and 3-week advancement in mean phenologies. Top: Simulations that used maximum estimates of pollinator activity periods. Bottom: Simulations that used minimum estimates. Values are averages across 1000 model runs. 95% confidence intervals are too small to be presented for all but the curtailments, and gaps + curtailment are too infrequent to show on the stacked graph. The predicted extreme percentages of all pollinator species suffering disruption in food supply (17–50%) derive, respectively, from a mean phenological advance of 1 week coupled with minimum estimates of pollinator activity periods, and from a mean advance of 3 weeks coupled with maximum estimates.

Fuente: Memmott et al. (2007) Ecol. Lett. 10: 710-717

Extinciones y estabilidad de las redes

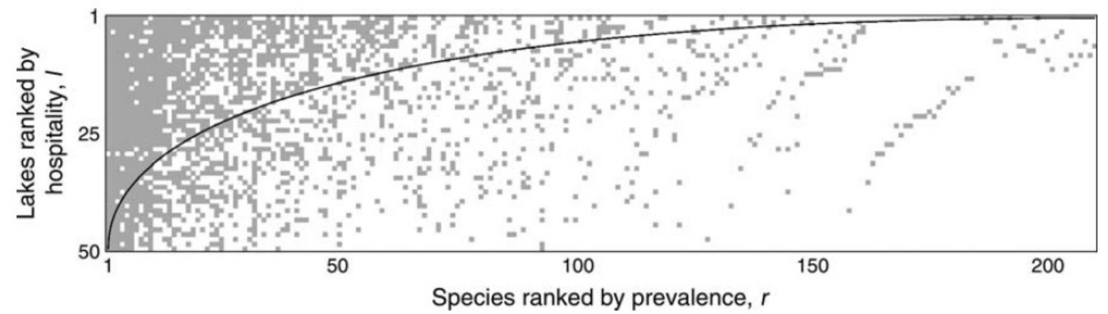
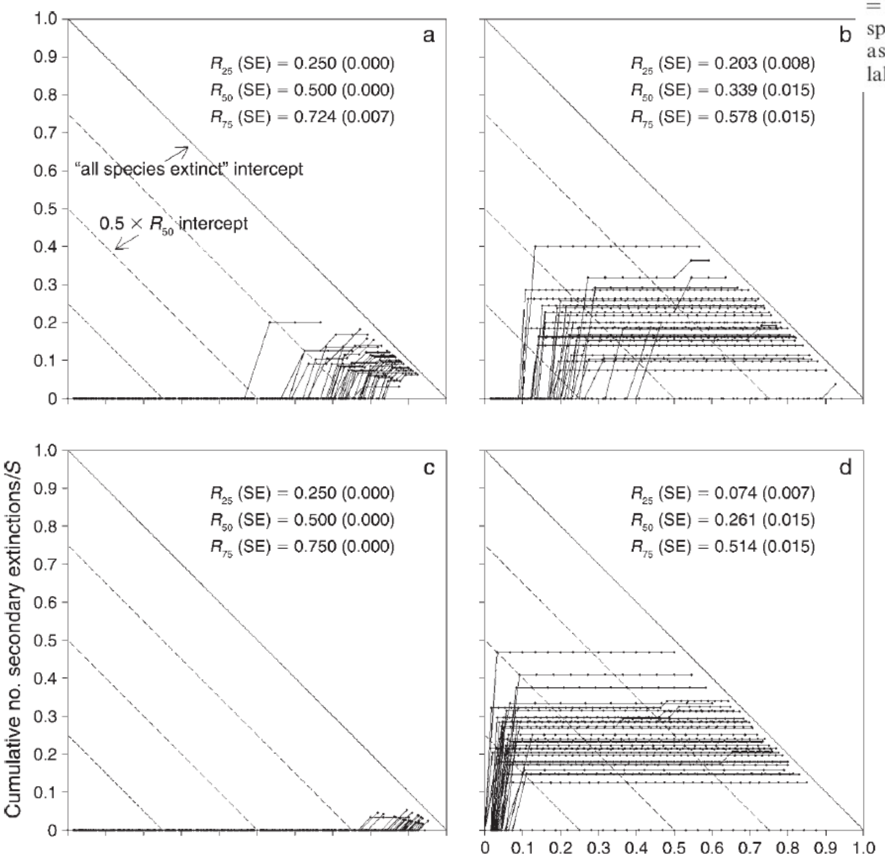


FIG. 1. Species × site occurrence matrix for 210 taxa in 50 Adirondack lakes after reorganization to maximize nestedness, N ($N = 0.80$, $P \ll 0.001$). A filled box represents the occurrence of a species in a lake. Data points are "mapped" by rank on the axes: species by prevalence (r, scale 1–210) and lakes by hospitality (l, scale 1–50). The curve represents the isocline of perfect nestedness as calculated by the Nestedness Temperature Calculator (NTC). The rankings of species by their prevalence across all lakes (r) and lakes by their hospitality to species (l) are illustrated.



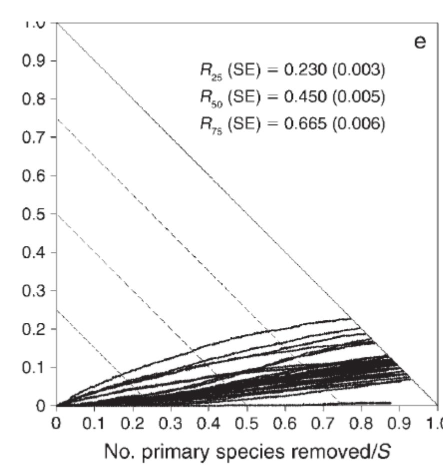
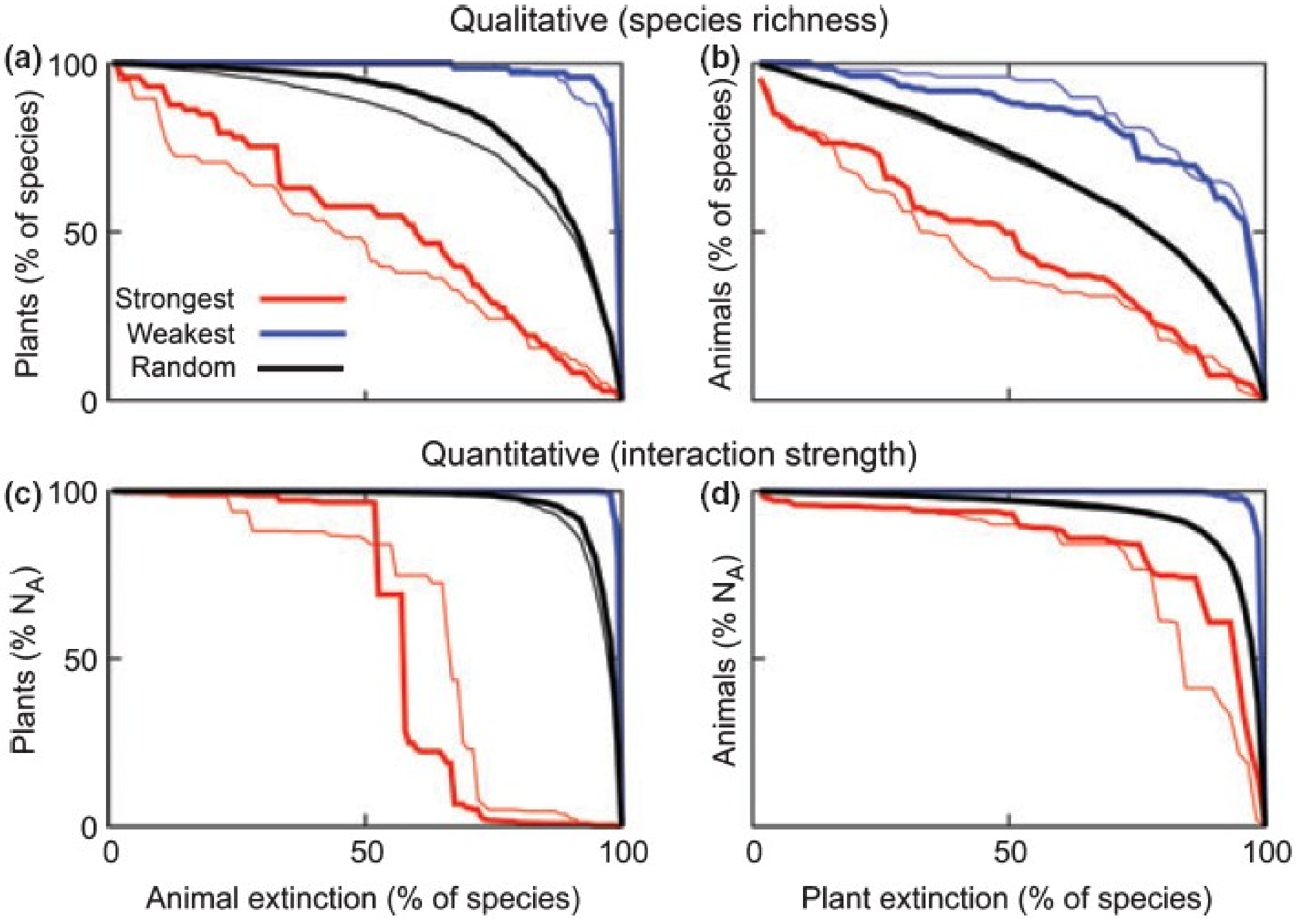


FIG. 2. Cumulative secondary extinctions due to primary species losses for 34 lake food webs using five extinction orders: (a) the order derived from nested-subset analysis, in which species are removed from least- to most-prevalent (normalized lake-specific rank $r_l = 1, \ldots 1/S$), where S is the number of species in a food web; (b) the reverse order, most- to least-prevalent ($r_l = 1/S, \ldots 1$); (c) least-linked to most-linked, considering links to consumers only; (d) most-linked to least-linked, considering links to consumers only; and (e) random removal averaged over 500 sequences for each lake. The solid lines in each plot indicate where the lake food webs disappear entirely, i.e., where primary plus secondary extinctions equal the total species richness of a lake. The dashed lines

Fuente: Srinivasan et al. (2008) Ecology 88: 671-682

Extinciones y estabilidad de las redes

Figure 1 Extinction plots upon systematic removal from the strongest or weakest interactor, and random removal. (a, b) Qualitative data, i.e. presence/absence of interactions; (c, d) quantitative data, i.e. interaction strength, both for the full-season networks. Thick lines (restored site) and thin lines (unrestored site) show extinction patterns of the different restoration schemes. The left panels (a, c) displays the decline of plant species and interaction strength following the removal of animal species, and the right panels (b, d) display the decline of animal species and interaction strength following the removal of plant species.



Fuente: Kaiser-Bunbury et al. (2010) Ecol. Lett. 13: 442-452

Extinciones y estabilidad de las redes

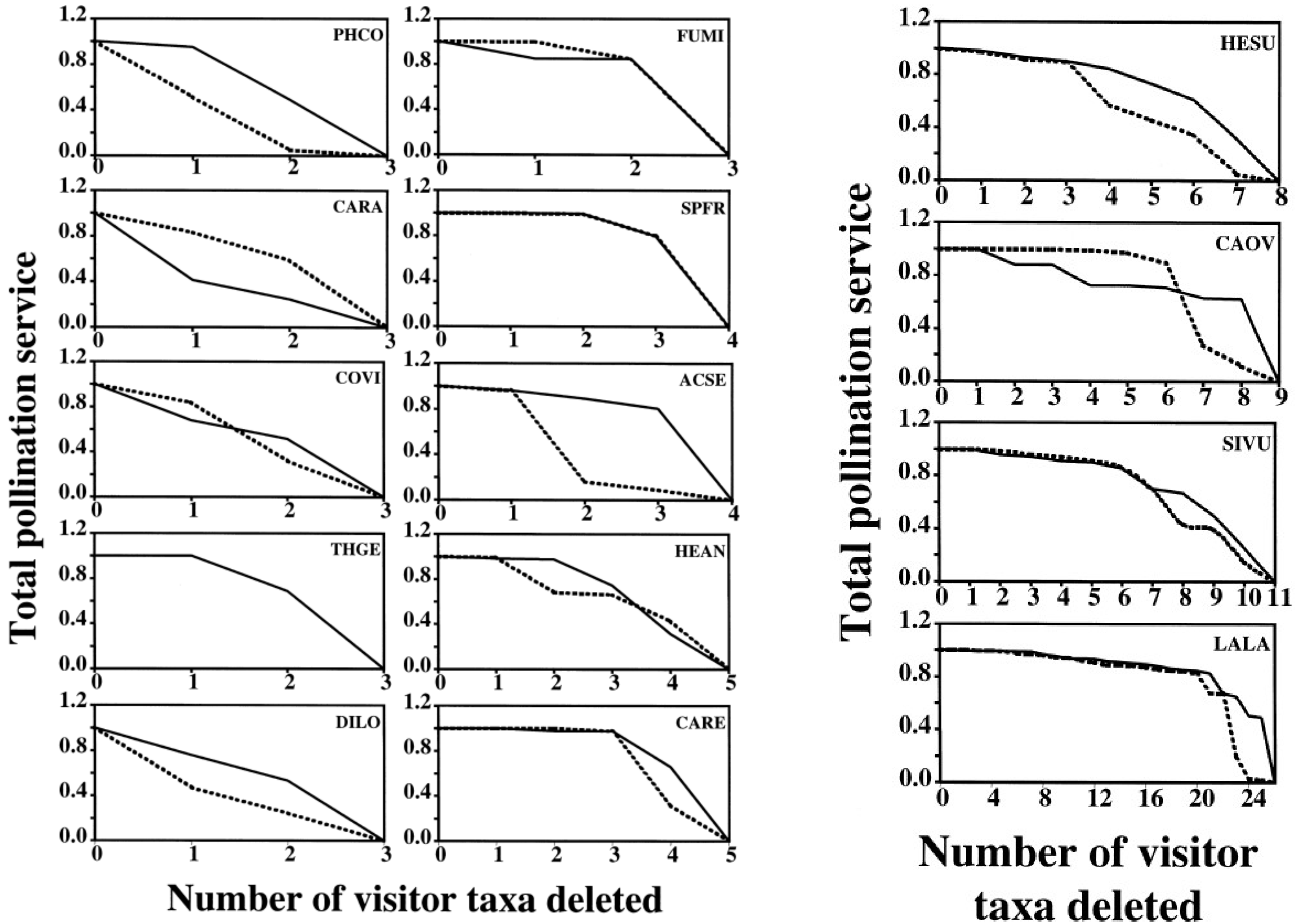


Figure 13.2 Decline in total pollination service as taxa are deleted from the visitor pool. Deletions were performed in order of increasing visitation frequency (solid lines) or increasing per-visit effectiveness (dotted lines). Lines overlap for THGE, SPFR, and PRVE. Species codes as in table 13.1.

Fuente: Morris (2003) En: The Importance of Species, Princeton University Press

Integración de exóticas en las redes

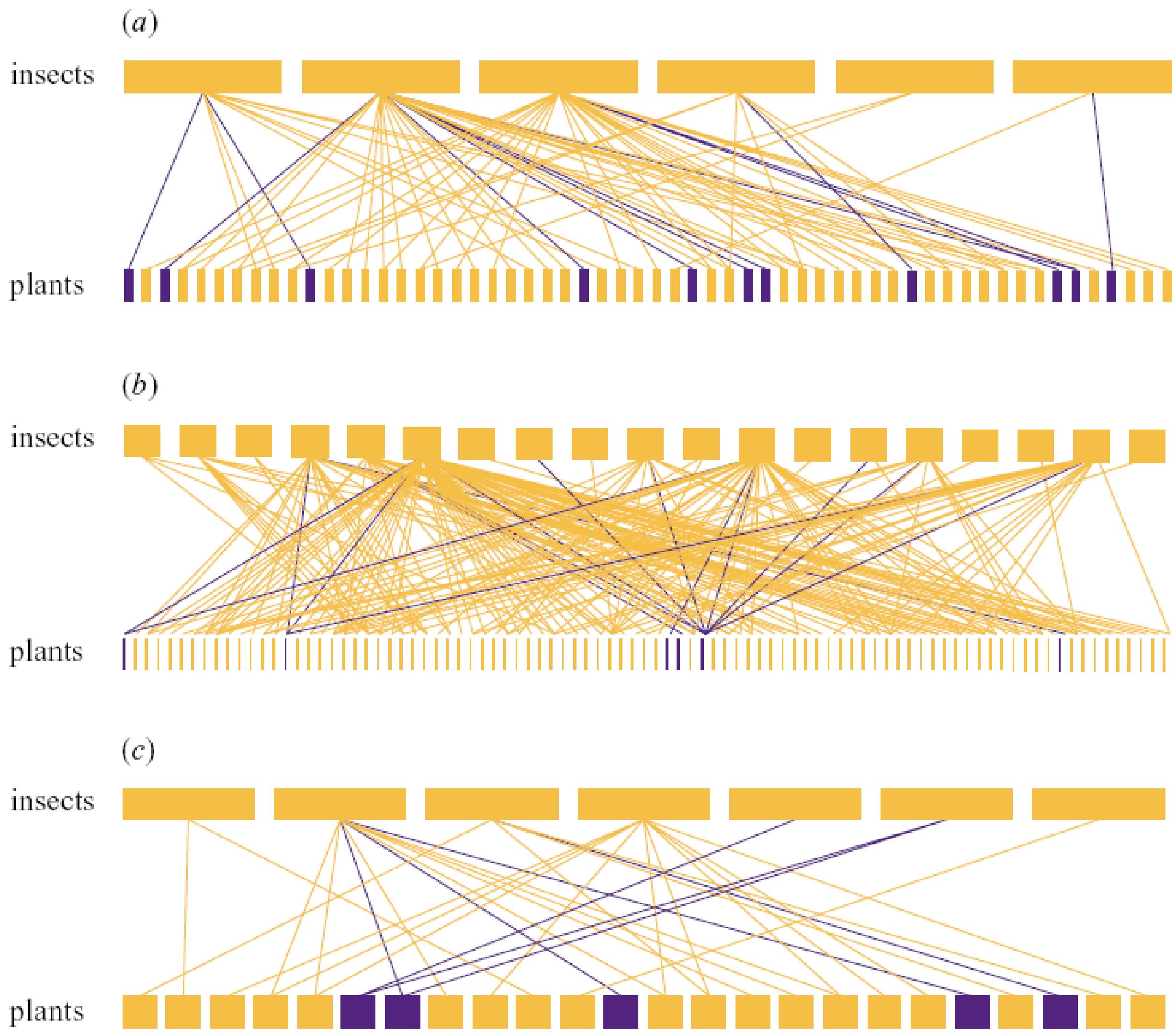


Figure 2. Three portions of the overall plant–flower visitor web, showing those interactions involving: (*a*) Anthophoridae (*sensu stricto*, Hymenoptera); (*b*) Sarcophagidae (Diptera); and (*c*) Sphingidae (Lepidoptera). Alien plant species and their interactions are shown in blue, and natives in yellow. Species names are omitted because they would be too small to be legible in some cases, and are not essential to visualize the integration of alien plants into the native web.

Fuente: Memmott & Waser (2002) Proc. R. Soc. B 269: 2395-2399

Impacto de exóticas en las redes

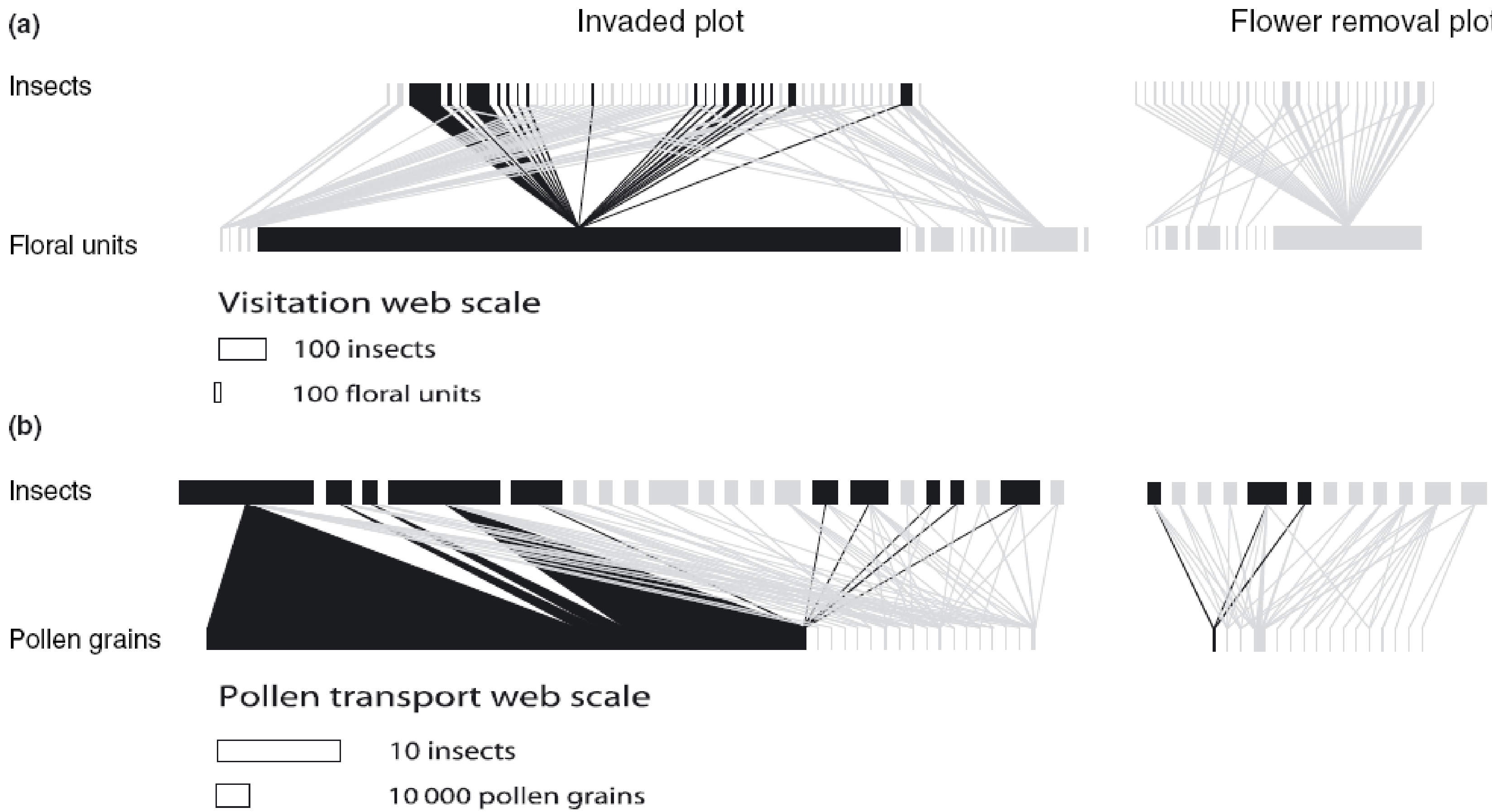


Figure 1 Visitation (a) and pollen transport (b) webs from invaded and flower removal plots for Site 1. In each web the rectangles represent insect species (top of each web) and plant species (bottom of each web), and the connecting triangles and lines represent links among species. In the visitation webs, the abundance of all species and the frequency of visitation are reflected by the width of the rectangles and basal width of the connecting triangles respectively. *I. glandulifera* and its links with visitors are shown in black and the two visitation webs are drawn to the same scale and thus are comparable. In the pollen transport webs pollen abundance is reflected by the rectangle width, and the pollen load carried by each insect species is reflected by the width of the connecting triangles. *I. glandulifera* and its links with visitors are shown in black. Note the pollen transport webs are based on a sub-sample of 20% of flower visiting insects whilst the visitation webs show all insects. The pollen transport webs are drawn to the same scale and are comparable.

Fuente: Lopezaraiza-Mikel et al. (2007) Ecol. Lett. 10: 539-550

Impacto de exóticas en las redes

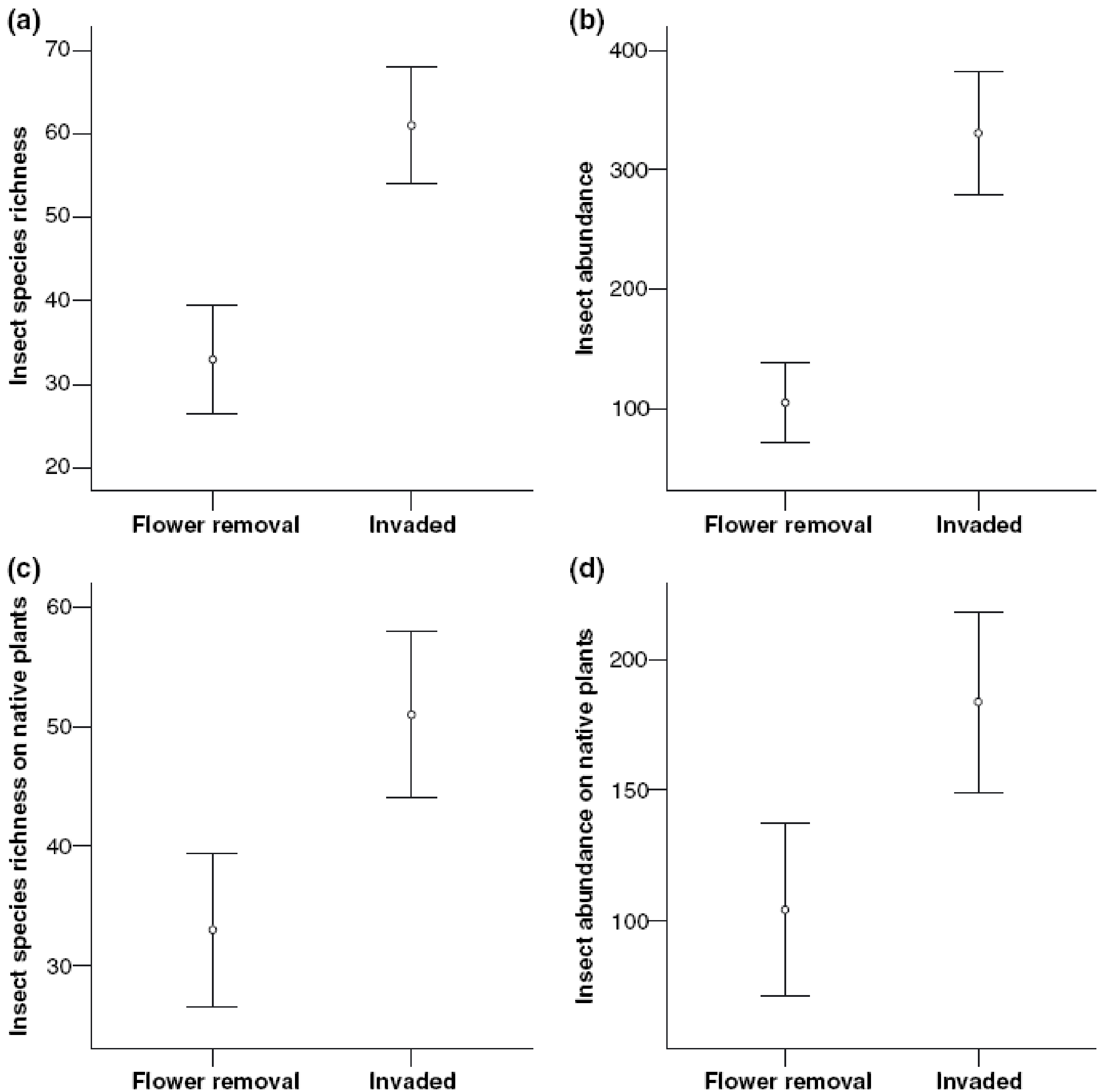
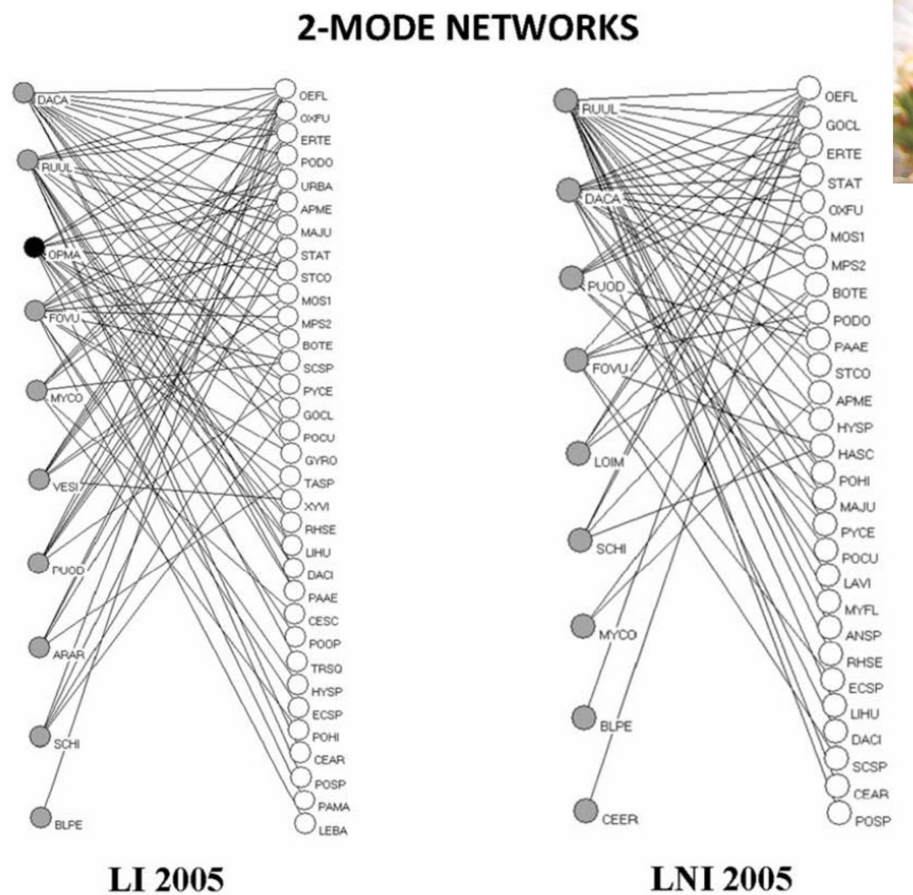


Figure 2 Flower visitor diversity and abundance at *I. glandulifera* invaded and *I. glandulifera* flower removal plots. (a) Overall species richness of flower visitors, (b) overall visitor abundance, (c) species richness of flower visitors to native plants, (d) visitor abundance on native plants. The error bars represent standard errors.

Fuente: Lopezaraiza-Mikel et al. (2007) Ecol. Lett. 10: 539-550

Impacto de exóticas en las redes



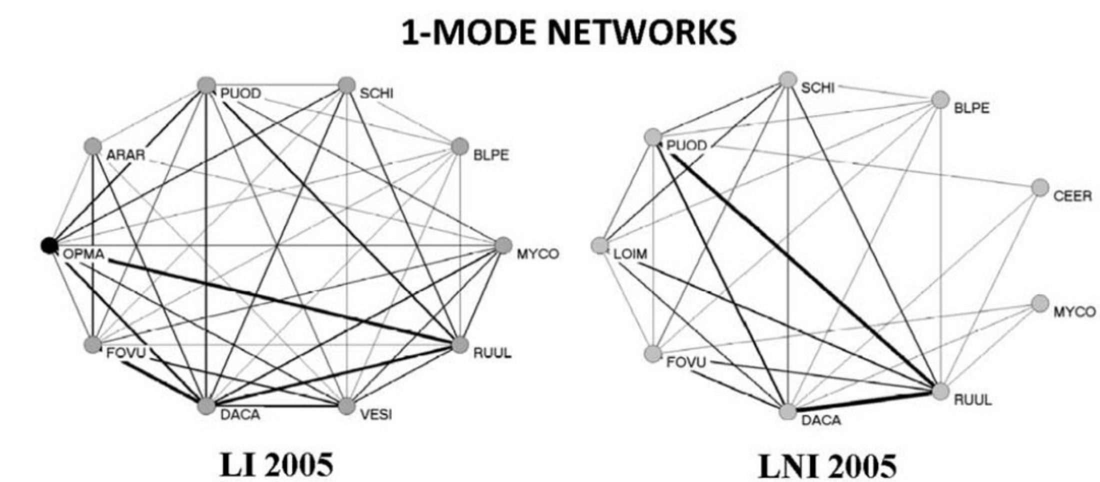


Figure 1. Representation of the bi-modal and uni-modal networks for Llimpa (Menorca; data from 2005). Plant species are shown as grey nodes and plant visitors as white nodes. *Opuntia* is the only black-coloured node. Links are shown as black lines connecting plants and pollinators. In the uni-modal networks, line thickness is proportional to number of insect species shared by plants. Note: **LI**, Invaded Llimpa site; **LNI**, Non-Invaded Llimpa site.
doi:10.1371/journal.pone.0006275.g001

Fuente: Padrón et al. (2009) PLoS One 4: e6275

Impacto de exóticas en las redes

Table 2. Results of Wilcoxon's tests analysing differences in the bi-modal and uni-modal network parameters.

alien effects		invaded sites		non-invaded sites		Z	*P*
		mean	**SD**	**mean**	**SD**		
2-mode	C (connectance)	0.0013	0.0007	0.0023	0.0015	−1.826	0.068
	N* (relative nestedness)	0.2489	0.0872	0.1682	0.1178	−1.461	0.144
	BR (Brualdi & Sanderson index)	0.1364	0.0993	0.0988	0.0213	−0.730	0.465
1-mode	d (link density)	0.0806	0.0317	0.1003	0.0243	−1.461	0.144
	DC (degree centralization)	0.2950	0.2042	0.3200	0.0616	−0.365	0.715
	CC (closeness centralization)	0.2867	0.1872	0.4533	0.0404	−1.069	0.285
	BC (betweeness centralization)	0.1300	0.1445	0.1475	0.1742	0.000	1.000
year-to-year variation		**2005**		**2006**		**Z**	***P***
		mean	**SD**	**mean**	**SD**		
2-mode	C (conectance)	0.0009	0.0001	0.0012	0.0005	−1.461	0.144
	N* (relative nestedness)	0.2365	0.1016	0.2704	0.0534	−0.365	0.715
	BR (Brualdi & Sanderson index)	0.1042	0.0415	0.1146	0.0460	0.000	1.000
1-mode	d (link density)	0.0719	0.0221	0.1077	0.0169	−1.461	0.144
	DC (degree centralization)	0.3025	0.1234	0.3900	0.2038	−0.730	0.465
	CC (closeness centralization)	0.3925	0.1261	0.4875	0.2045	−1.095	0.273
	BC (betweeness centralization)	0.1000	0.0779	0.2075	0.2385	−0.730	0.465

Alien effects were tested using pairs of sites (invaded *vs.* non-invaded) observed in 2005. Year-to-year variation was observed comparing only the pairs of sites observed two consecutive seasons. *C*, *BR* and *d* have been corrected for network size when performing the analyses.
doi:10.1371/journal.pone.0006275.t002

Fuente: Padrón et al. (2009) PLoS One 4: e6275

Impacto de exóticas en las redes

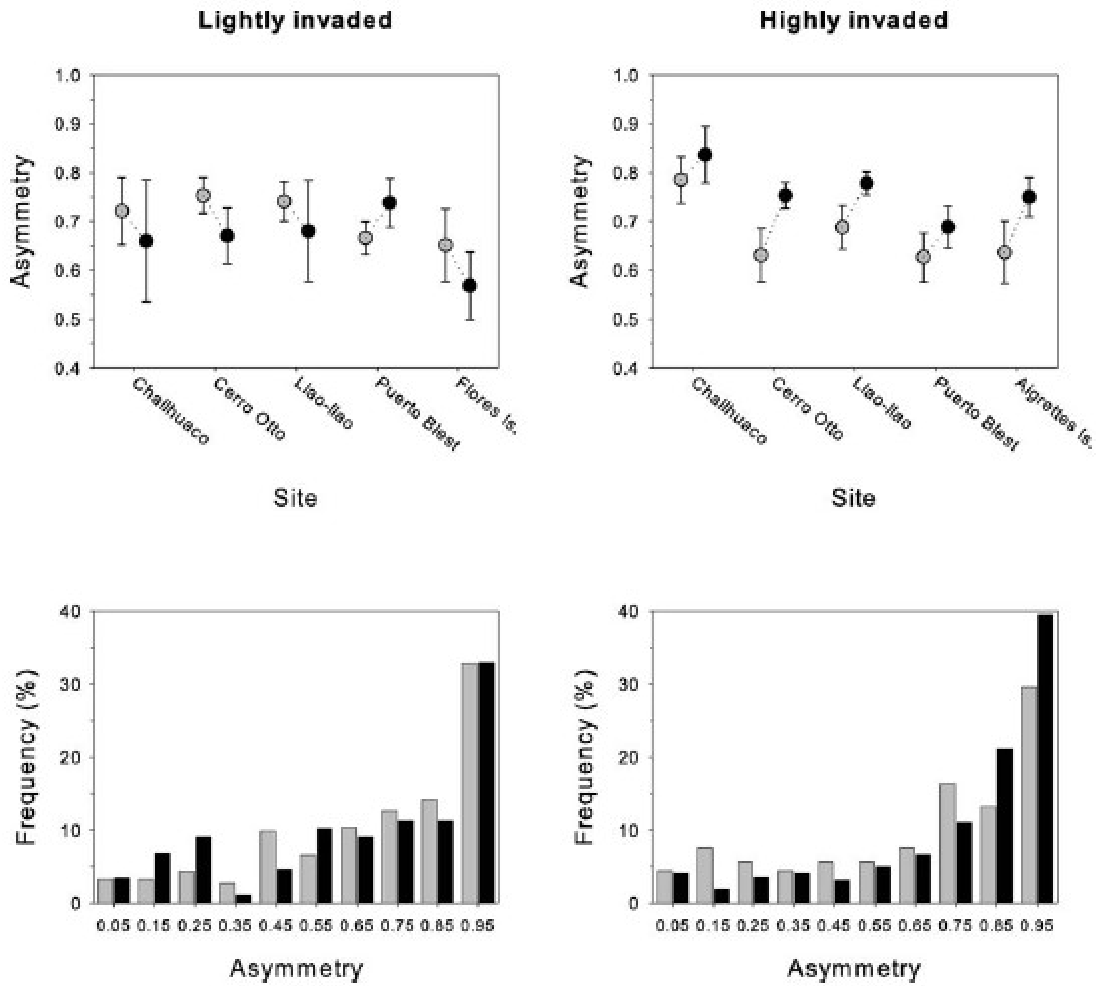


Figure 2. Means and Composite Frequency Distributions of Interaction Asymmetry for Pairs of Interacting Species

The graphs depict asymmetries for interactions recorded in lightly invaded and highly invaded webs. Gray dots (upper panels) and bars (lower panels) indicate asymmetries for pairs of interacting native species, and black dots and bars depict pairs of interacting species in which at least one is alien. Sample sizes for each mean and frequency distribution can be derived from the column "Number of links" in Table 1. Error bars represent one standard error.

Fuente: Aizen et al. (2008) PloS Biol. 6: e31

Redes: Estudios de caso

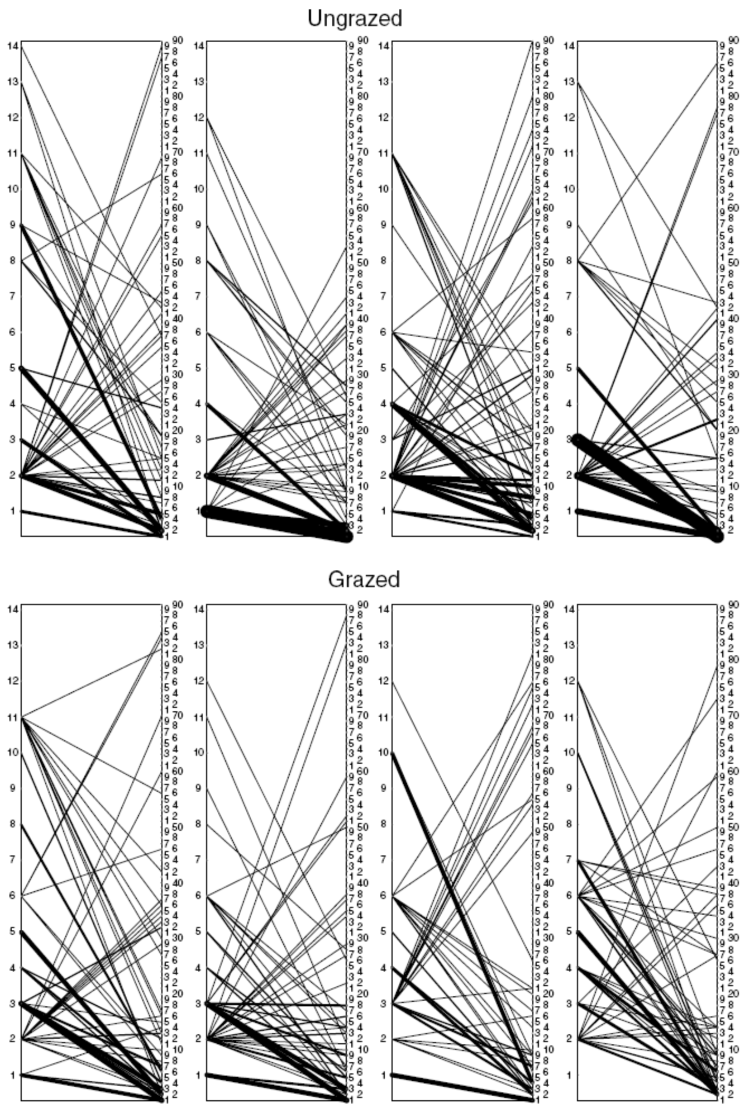


Figure 1 Plant–pollinator interaction networks in the eight sites. In each network, lines indicate pairs of interacting species; end points of lines represent plant (left) and pollinator (right) species. Species identities are indicated by numbers (see Supplementary Material for names; notice that only first digit is given for pollinator species, except for multiples of 10). Line thickness is proportional to the square root of the standardized frequency of interaction between the plant–pollinator species pair. Upper row, ungrazed sites (from left to right: Llao Llao, Safariland, Lago Mascardi, Península Quetrihué); lower row, grazed sites (from left to right: Cerro López, Arroyo Goye, Lago Mascardi, Península Quetrihué). Grazed and ungrazed sites in the same geographical location are vertically aligned.

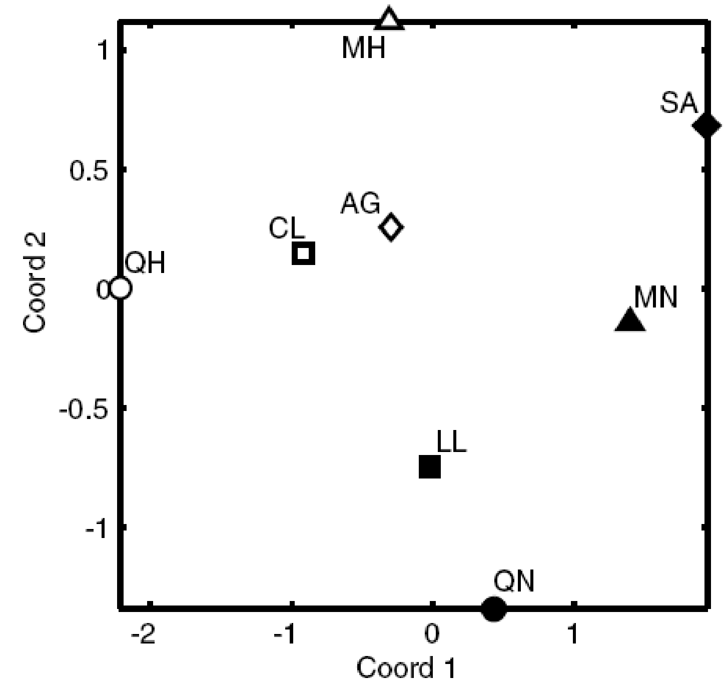


Figure 2 Reduced-space plot of first two coordinates resulting from nonmetric multidimensional scaling (MDS). White symbols: grazed sites (CL, Cerro López; AG, Arroyo Goye; MH, Mascardi; QH, Quetrihué); black symbols: ungrazed sites (LL, Llao Llao; SA, Safariland; MN, Mascardi; QN, Quetrihué). Paired sites are represented by the same symbol. The good fit of the linear regression of the distance among original descriptors (x) vs. those obtained after reduction with MDS (y) suggests that reduced-space scaling is a good representation of the data ($y = 0.2236 + 0.9037x$; $P < 0.0001$; $R^2 = 0.89$; Legendre & Legendre 1998).

Fuente: Vázquez & Simberloff (2003) Ecol. Lett. 6: 1077-1083

Redes: Estudios de caso

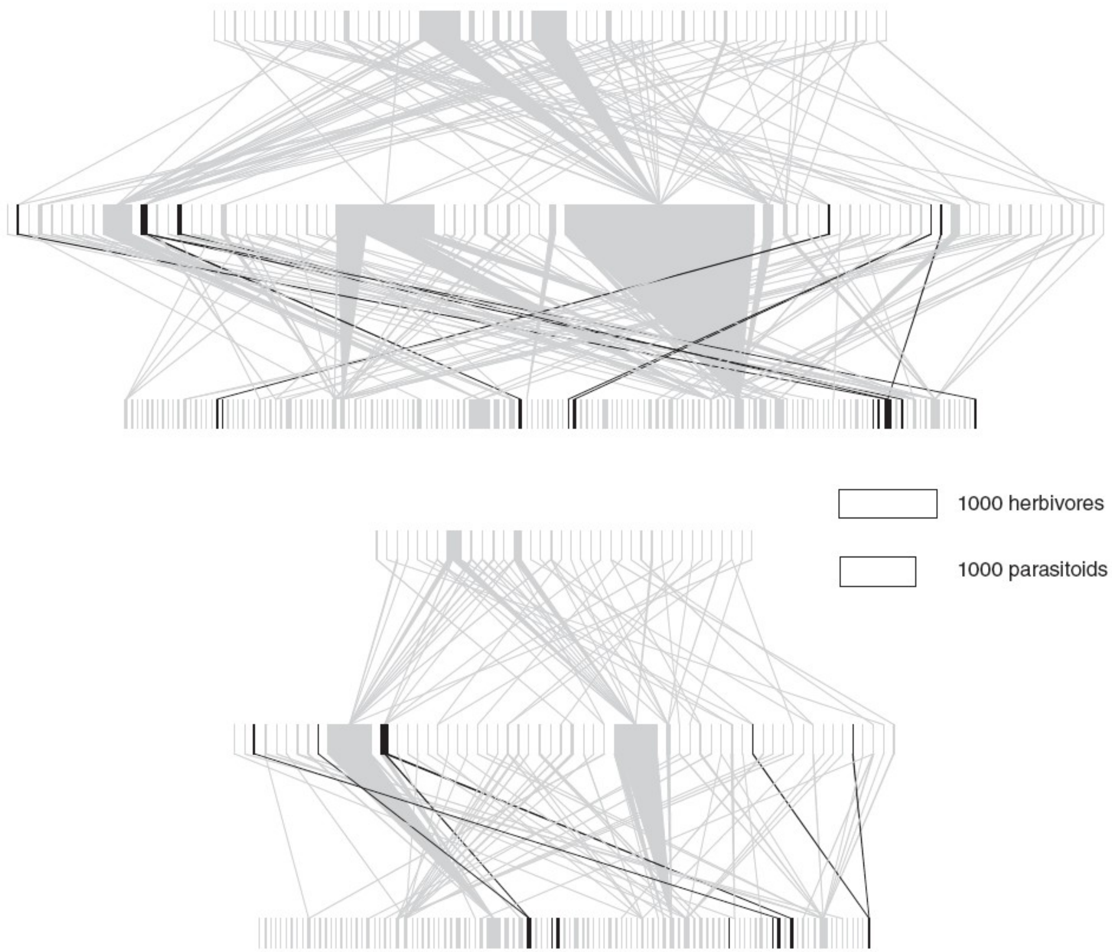


Figure 1 One of the 10 pairs of farm networks. The bottom level of each web shows all the plant species sampled on the farm, the middle level the insect herbivores and the top level the parasitoids. Each bar indicates a different species, and for herbivores and parasitoids the width of the bars represents their abundance on the farm; plants were given an abundance measure on a scale of 1–4. The lines between trophic levels indicate that these two species are interacting and the width of the lines indicates the frequency of this interaction. Arable plant species and their herbivores have been shaded black.

Prediction 2. Organic and conventional farms have a different network structure

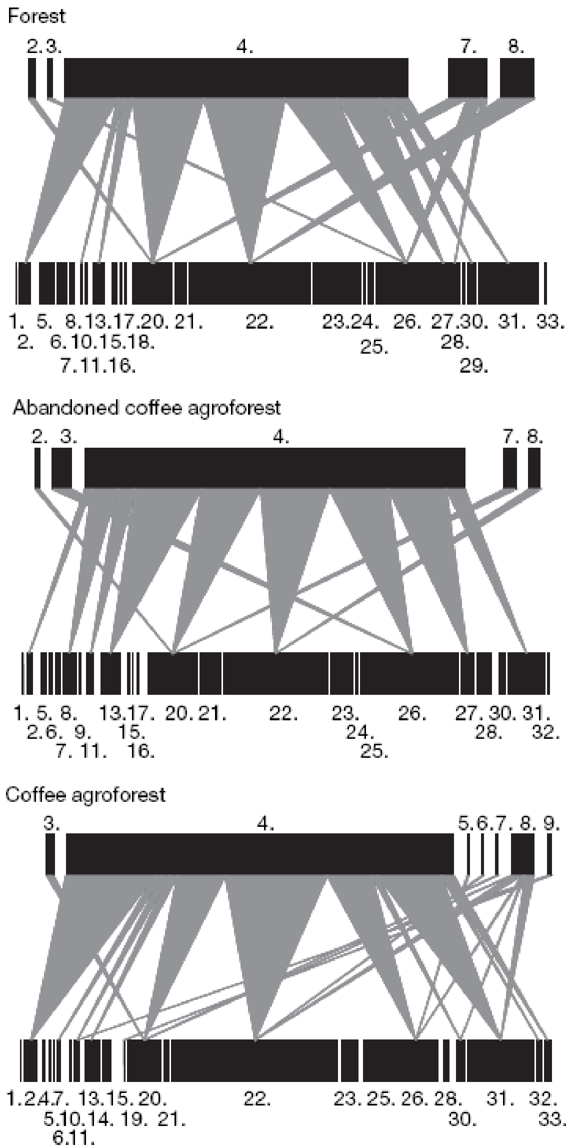
The partial mantel tests revealed that network topology was different between the two farming systems. Thus there was a significant relationship between species interaction frequencies and farming system when controlling for the effect of geographical pairing ($r = -0.1806$, $P = 0.017$). When the independent matrices were reversed (pair first, then system), we found no significant relationship between geographical pairing and species interaction frequencies when farming system was held constant ($r = -0.0725$, $P = 0.126$), indicating that the differences in species interaction frequencies are more strongly determined by farming system than the geographic location of the farms. This analysis was repeated after rare interactions had been removed from the data set, with the same outcome (System first, then Pair: $r = -0.1803$, $P = 0.017$; Pair first, then System: $r = -0.0733$, $P = 0.125$).

Prediction 4. Organic farms have a higher robustness to species loss

We found no difference in robustness (Dunne *et al.* 2002) between organic and conventional networks under any of the three scenarios (random: Z = −0.510, $P = 0.610$; least connected: Z = −1.580, $P = 0.114$; most connected: Z = −0.663, $P = 0.508$). Networks were moderately sensitive to the loss of least connected species first, with 32–43% of primary removals required before a total species loss of 50% was reached. As expected, robustness was much lower when removing most connected species first (9–18% of primary removals). When species were removed at random, 27–32% of primary removals was required.

Fuente: MacFayden et al. (2009) Ecology Letters 12: 229–238

Redes: Estudios de caso



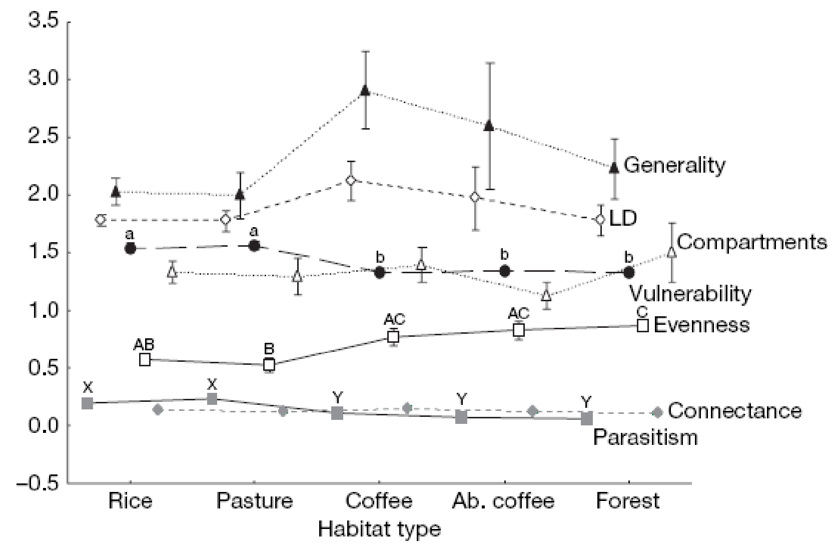


Figure 2 | The effects of habitat modification on rates of parasitism (mean ± s.e.m.) and six quantitative food web metrics (see Supplementary Methods 1): linkage density (LD), generality, vulnerability, evenness, connectance and compartment diversity. Letters above individual means indicate significant differences among habitat types for that particular metric. Letters in common or no letters indicates no significant difference.

Fuente: Tylianakis et al. (2007) Nature 445: 202–205